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A VISTA OF THE MAJESTIC HUDSON CAUGHT FROM A POINT HIGH ON  
THE WOODED CREST OF THE SCENICALLY NOTED PALISADES

## Air-Driven Tools and Their Manufacture

R. G. Skerrett

## Improved Methods Increase Oil-Field Output

A. S. Taylor

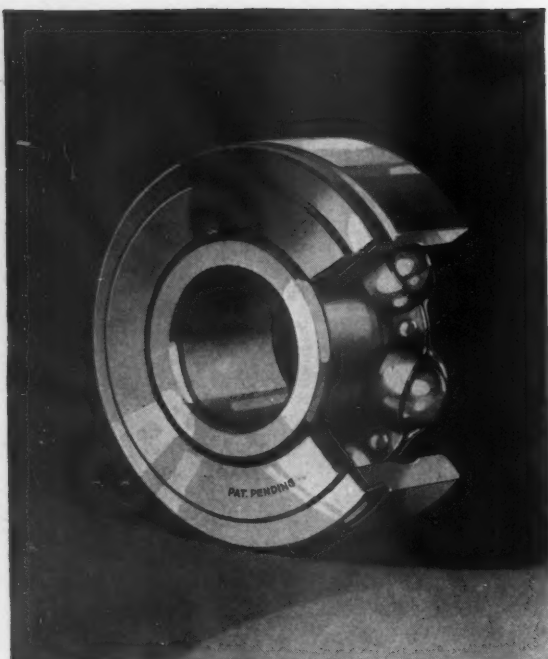
## Curb Market Again Outgrows Its Quarters

L. H. Burns

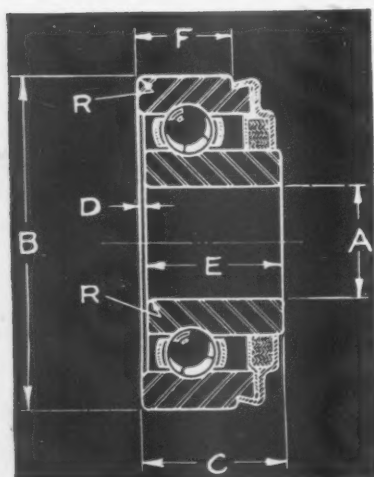
## Witwatersrand Still Leads in Gold Output

Owen Letcher

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# Another "PRECISION" Bearing



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showing details of application

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Bearing Number	Bore "A"		O. Dia. "B"		Width "C"	Offset "D"	Length "E"	Width "F"	RAD. "R"	
	M. M.	Inches	M. M.	Inches					M. M.	Inches
GS-96	6	.2362	19	.7480	.3543	.016	.3383	.2362	1	.039
GS-97	7	.2756	22	.8661	.4060	.016	.3900	.2756	1	.039
GS-98	8	.3150	22	.8661	.4060	.016	.3900	.2756	1	.039
GS-98246	6	.2362	24	.9449	.4060	.016	.3900	.2756	1	.039
GS-98247	7	.2756	24	.9449	.4060	.016	.3900	.2756	1	.039
GS-9824	8	.3150	24	.9449	.4060	.016	.3900	.2756	1	.039
GS-99	9	.3543	26	1.0236	.4527	.016	.4367	.3150	1	.039
GS-200	10	.3937	30	1.1811	.5118	.016	.4958	.3543	1	.039
GS-201	12	.4724	32	1.2598	.5512	.016	.5352	.3937	1	.039
GS-202	15	.5905	35	1.3780	.5905	.016	.5745	.4330	1	.039
GS-203	17	.6693	40	1.5748	.6693	.016	.6533	.4724	1	.039
GS-204	20	.7874	47	1.8504	.7480	.016	.7320	.5512	1	.039
GS-205	25	.9843	52	2.0472	.7874	.016	.7714	.5906	1	.039

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# As It Seems To Us

## WATER REJUVENATES FAILING OIL FIELDS

JUST because oil and water are naturally ill-disposed to mix, petroleum is now being won in a very promising measure from certain pools in the states of New York and Pennsylvania. This heartening economic situation is the present anticlimax to a condition that seemed not so many years ago to indicate the approaching end of an industry that had endured in those states for a goodly number of decades. Such has been the unexpected outcome of an accidental procedure that has been developed and applied along scientific lines.

Ever since 1864—five years later than was the case in Pennsylvania—oil was struck in New York State in Cattaraugus County; and again in the early “eighties” prospectors penetrated to an oil-bearing sand in Allegany County. The two producing areas in their prime had a combined annual output of more than 5,000,000 barrels. But beginning about 1886 and continuing down to 1912 there was a more or less marked decline in yield; and in 1912 production was but little more than 750,000 barrels. The outlook was discouraging; and, despite extensive drilling, oil could not be found beyond the rather limited areas of the known pools.

Just when the outlook appeared darkest it was discovered that oil could be recovered from some abandoned wells that had lain idle for more or less protracted periods; and investigation revealed that this state of affairs was due to the action of water that had been permitted to flood neighboring wells—in that way applying hydrostatic pressure to the sands and causing some of the oil to move to the abandoned but unflooded wells. Needless to say, there were alert operators who promptly interpreted the situation aright and lost no time in doing deliberately what had come to pass through neglect or accident. This was the beginning of the practice of “flooding,” which has lately acquired a new significance, especially in the oil fields of New York and Pennsylvania.

Today flooding is practiced in a thoroughly systematic way, and is the result of much experimenting—not all of the schemes having proved worth while. In the beginning the flooding action was produced simply by turning water into the wells and relying upon the resulting hydrostatic heads; now the procedure is more comprehensive, because additional pressure is applied at the heads of the wells through the agency of powerful pumps. This added pressure may be as high as 1,000 pounds or more, and may be applied to the producing sands for months before any oil appears at the pumping well located in the center of a group of water wells. The procedure is an expensive one; but it pays for itself because of the superior character of the paraffin-base oil so recovered.

It is authoritatively estimated that flooding will permit the winning of more oil than the fields have produced in the past; and experts declare that the pools will have a commercial life reaching from 30 to 50 years into the future.

## HYBRID POPLARS MAY PRODUCE ABUNDANT PULPWOOD

AFTER extensive experiments, Dr. RALPH H. MCKEE, head of the department of chemical engineering of Columbia University, has succeeded in producing a hundred or more hybrid poplars from something like a score of different species of that widely known tree; and from his hybrids he has picked out fourteen that promise to be especially valuable as a potential source of pulpwood—the pulp to be used in the manufacture of newsprint and rayon.

According to Doctor McKEE's conclusions, certain of his hybrid poplars will attain in eight years a growth reached by ordinary poplars in the course of nearly half a century. An acre of mountain land, for example, will yield in eight years pulpwood to the value of \$600 as a return for a planting outlay of but \$5. Apart from thus showing us a way to insure ourselves a domestic abundance of a highly desired sort of pulpwood, Doctor McKEE's researches indicate how the farmer can turn uncultivable lands into a source of revenue. The McKEE hybrids may eventually prove a great boon, inasmuch as cellulose is being put to ever-increasing uses.

## HISTORIC ST. PAUL'S CATHEDRAL FACES NEW MENACE

ST. PAUL'S Cathedral in London has appealed to hundreds of thousands of people since it was finished 220 years ago. It has appealed because of its monumental proportions and because of the manifest skill that must have been exercised by its designer, Sir CHRISTOPHER WREN. To the engineer and to the modern architect the structure appears all the more remarkable recognizing the comparatively simple facilities with which the builder had to work in those distant days. Sir CHRISTOPHER said the cathedral would certainly stand for 200 years; but it is doubtful whether he then realized to what extent the edifice would be imperiled before the completion of that period.

It is fairly common knowledge that work on the weakened structure has been in hand for substantially fifteen years. This has consisted mainly of grouting operations intended to consolidate and to strengthen the eight immense piers that support the dome. The pressure grouting is now finished, and

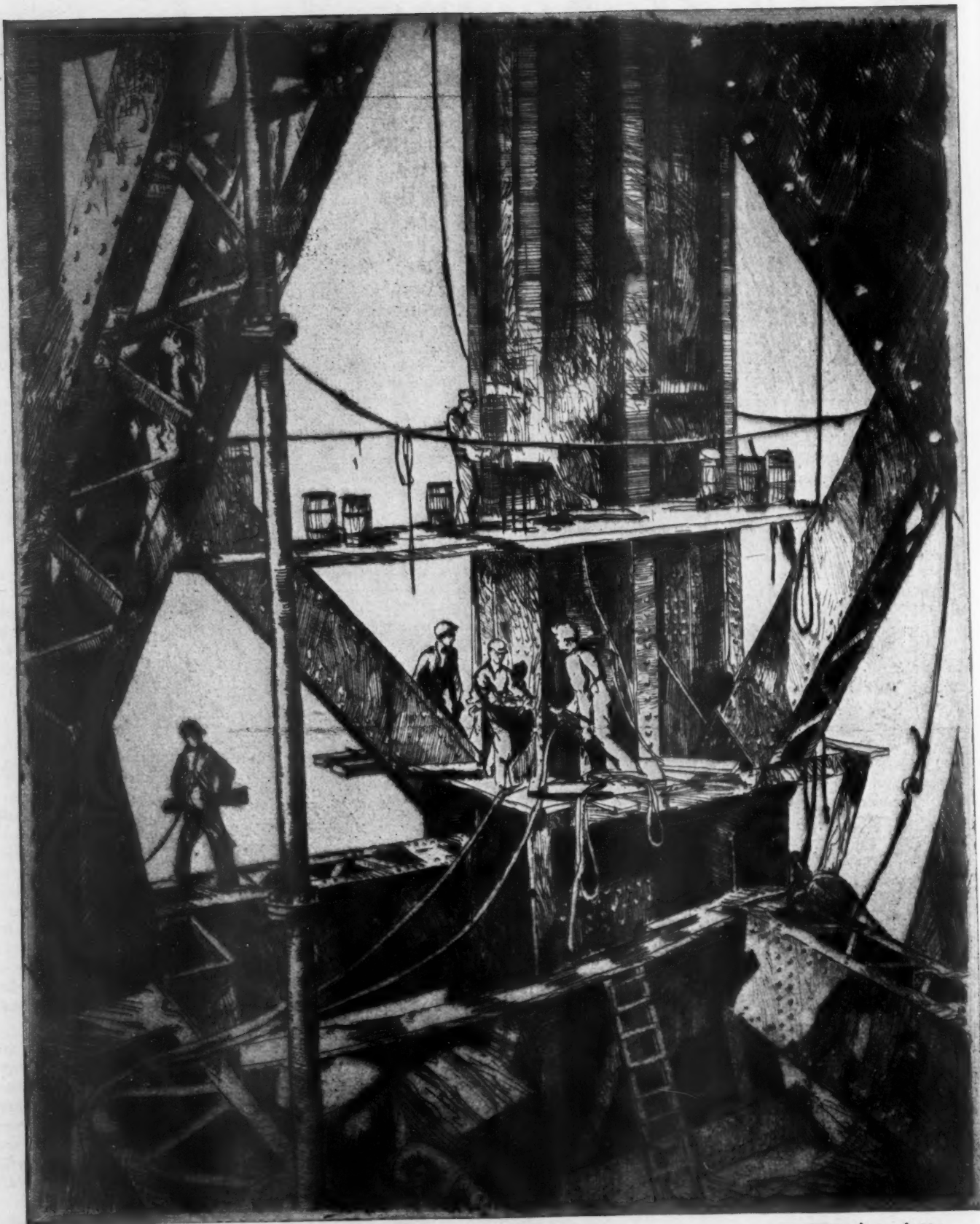
there is to be a formal celebration of this event in June. While the public generally assumes that the cathedral will hereafter be secure against further subsidence, such, unhappily, is not the case, and all because of the nature of the underlying ground.

The foundations of St. Paul's have a vertical depth of but  $4\frac{1}{2}$  feet, and beneath the building lies only 6 feet of earth superposed upon a saturated stratum of sand 20 feet deep. The presence of water in the sand is indispensable to the stability of the edifice. If new buildings with deep foundations supplant the old nearby structures, the newer and deeper foundations would cut off the water which now flows from springs in the neighborhood and passes from north to south below the cathedral. Without this water as a partway support the sand would dry and settle, and St. Paul's would subside correspondingly. Such a movement might undo the strengthening work lately completed, and the structure might be subjected to more serious stresses than heretofore. With leases expiring soon in the cases of buildings north and south of the cathedral, and the likelihood of their demolition and the erection of up-to-date structures, the situation is occasioning a good deal of anxiety among the church authorities.

## PUTTING ANOTHER RARE METAL TO USE

FOR considerably more than a hundred years the mineral beryllium was scarcely more than a laboratory curiosity, and the extremely limited quantities available made it an expensive rarity. Attention has recently been focused on this metallic chemical element by reason of deposits discovered in the Styrian Alps, which are estimated to hold ores capable of yielding a million or more tons of the mineral. At the current price for beryllium—\$200 a pound—the value of the Austrian deposits is enormous.

Alone, pure beryllium has to date but a single commercial use, being employed for the windows of certain X-ray tubes; but its field of service as an alloy may eventually prove a wide one because beryllium imparts very desirable characteristics to other metals even when a small percentage of it is utilized for this purpose. The modulus of elasticity of beryllium is high, being nearly three times that of magnesium; and there is a possibility that beryllium may lead to the making of a series of light-weight structural alloys that would be found very useful in the building of aircraft. Undoubtedly, a sufficient demand for beryllium would warrant production operations that will permit its sale at a profit around \$25 a pound. Such is the recurrent story of the wonders of modern metallurgy.



Courtesy, Advertising Arts, and  
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### *The Riveters*

*Opus*

*At work on one of the great towers of the Fort Lee-Fort Washington  
Bridge across the Hudson River*



# Air-Driven Tools and Their Manufacture

*The Astonishing Development of an Industry Typified by the Plant at Athens, Pa., of the Ingersoll-Rand Company*

An Ingersoll-Rand pneumatic grinder being used to finish the casing of an air hoist in the Athens plant.

By R. G. SKERRETT

**B**-R-R-R-RUP, b-r-r-r-rup, b-r-r-r-rup, rup, rup, rup. From hundreds of feet above us came this vigorous replica of a sturdy woodpecker in action. Craning our necks, until they hurt, we saw silhouetted high against the sky a couple of men putting the finishing touches on the steelwork of a towering office building. We knew, then, that the sound we heard was produced by an air-driven riveting hammer that was binding structural parts so firmly that they would be safe and permanent for years to come—no matter what stresses might be put upon them by their normal loads and by wind and weather.

Some of us, viewing that typical example of modern architecture, could easily recall the time when well-nigh all rivets for a similar purpose were driven by hand—the work calling for the skillful and the tiring use of hand hammers that could be employed efficiently only when the riveter could swing his hammer freely and fast enough to complete his task before the rivet chilled, when it could not be made tight.

The development of the air-driven riveting hammer has been a mechanical accomplishment accepted generally without comment and usually without appreciation. Even so, the pneumatic riveting hammer has revolutionized the work of assembling steel structures of many kinds; and it has made it possible to do that essential work faster than was previously practicable and, in numerous instances, better the day through and with less of an exhausting demand upon the muscles of the operator.

The riveting hammer, let it be known, is but a single type among many tools that are now actuated with compressed air. The purpose of all these tools is to save time, to lighten labor, and to do good work even in cramped places—that is, in places where hand tools could be employed only with difficulty, if at all. Of course, the ever-widening availability of compressed air is the foundation upon which the pneumatic-tool industry has been built. Compressed air possesses certain inherent advantages as a motive medium; and, because of this, engineers and inventors have devised agencies that could make use of it to advantage. Just how much success has crowned

these efforts is evidenced by the types of tools that those men have produced.

In the course of the last twenty years the development of pneumatic tools has advanced at a remarkably rapid rate; and in one form or another they can be found in virtually every industry to a greater or lesser extent. Adaptability is their outstanding characteristic; and, as in the case of the telephone, we wonder how it was possible in the past for our workers to get along without these admirable aids. They got along because they did not achieve as much in a given time as their fellows of today do; and, conversely, the wage earner then did not have the number of leisure hours that he now has at his disposal after doing a good and remunerative day's work. Indeed, relatively few of us realize how much pneumatic tools have contributed to the social and material betterment of people gainfully employed.

One might fill a sizable volume with the recital of the manifold services to which pneumatic tools are put at the present, but it would probably bewilder and weary the reader before he were halfway through. Instead, let us leave something to his imagination and tell him just a few of the outstanding things that pneumatic tools do for him. The modern motor car could not be built as well as it is and sold at the price at which it is now marketed if much of the assembly work were not done with pneumatic tools. These tools do more than merely minimize the measure of manual work required in repetitive tasks—they insure each operation being done well and thoroughly, hour in and hour out, so



This special steel piston of a riveting hammer underwent nine operations and as many inspections before it reached the stage illustrated.



Left—This hydraulic testing machine, in the physical laboratory of the Athens plant, is capable of developing a pressure of 2½ tons. Right—Testing gages used in the shops with Johansson blocks that are accurate within four-millionths of an inch.

that each car of a given type is virtually identical in workmanship with all of its group.

Wherever locomotives and railway cars are built, or where such rolling stock is regularly overhauled and repaired, a great many of the operations are performed with pneumatic tools. Similarly, pneumatic tools are extensively utilized in assembling and in maintaining the tracks over which our thundering trains speed on their several and diversified services. Not only must these backbones, so to speak, of our great transportation systems be kept fit, but it is equally essential that the work be done rapidly so as to interrupt or to check as little as possible the flow of traffic. Indeed, in some particulars, the road-bed maintained with air tools is authoritatively said to be superior to that maintained with hand tools.

In steel and iron mills, in bridge-building and boiler shops, in plants turning out tanks great and small, in shipyards, in foundries, in machine shops, in many factories, and in all sorts of engineering and construction undertakings, pneumatic tools do a diversity of work for which they are inherently suited or for which they have been cunningly adapted. In short, the present trend in industry generally is to use pneumatic tools of an appropriate sort wherever feasible. This attitude, if made vocal, would probably be expressed by such a phrase as: "Do it with

air if you can".

The pneumatic tools now available represent years of developmental work. One by one they have been devised and then improved upon in a ceaseless effort to better their performances, to increase their ruggedness, to make them more fit for particular services, and to effect gains in operating economy. Only the men directly concerned in accomplishing these results know how many obstacles had to be overcome, how many difficulties had to be mastered, and how many resources had to be drawn upon before success was won. More than once the mechanical problem was interwoven with a human problem—that is, the attitude of the worker towards the pneumatic tool.

It is an inescapable fact that the operator generally expects the tool given him to do its part well and at the same time to tolerate a

good deal of careless or indifferent treatment. This is no reflection upon pneumatic-tool users as a class—it is but another expression of the viewpoint of the vast majority of persons towards labor-saving mechanical aids. The belief persists that the machine should impose a minimum of obligation on the handler and yet give a maximum of good performance whenever and wherever called upon to do so. One does not have to be an engineer to realize that this state of mind places an extremely heavy burden upon the shoulders of the manufacturer.

In order to really lighten labor, the pneumatic tool for any field of service must not be over heavy—indeed, for the majority of services, it is highly desirable that the weight be kept down to the lowest limits consistent with structural strength, general ruggedness, and the development of the necessary operating power. This

means that the metal for each and every part must be chosen with the utmost care. Accordingly, due regard should be given to metallurgical discoveries that permit of any reduction in the weight or the size of parts without a sacrifice in strength or in wearing qualities. Assuming that the design of the tool and the choice of the metals going into it are all that skill can determine, then the qualifications of the different working parts for service may be measurably enhanced by nicely controlled heat treatments. Heat-treating is one of



Assembly department where all pneumatic tools other than holsats are put together.



1—This is what is known as a G-hoist, which is suspended from another air hoist while the operating cable is being fastened to it. 2—The air-hoist assembly department, where these very adaptable machines are put together. 3—Dolling up air hoists with pneumatically sprayed paint. 4—A group of eleven air-hoist motors being run in with oil for a period of from fifteen to twenty hours. 5—Every air hoist is required to raise a prescribed load in a given time and to undergo other tests that approximate service conditions.

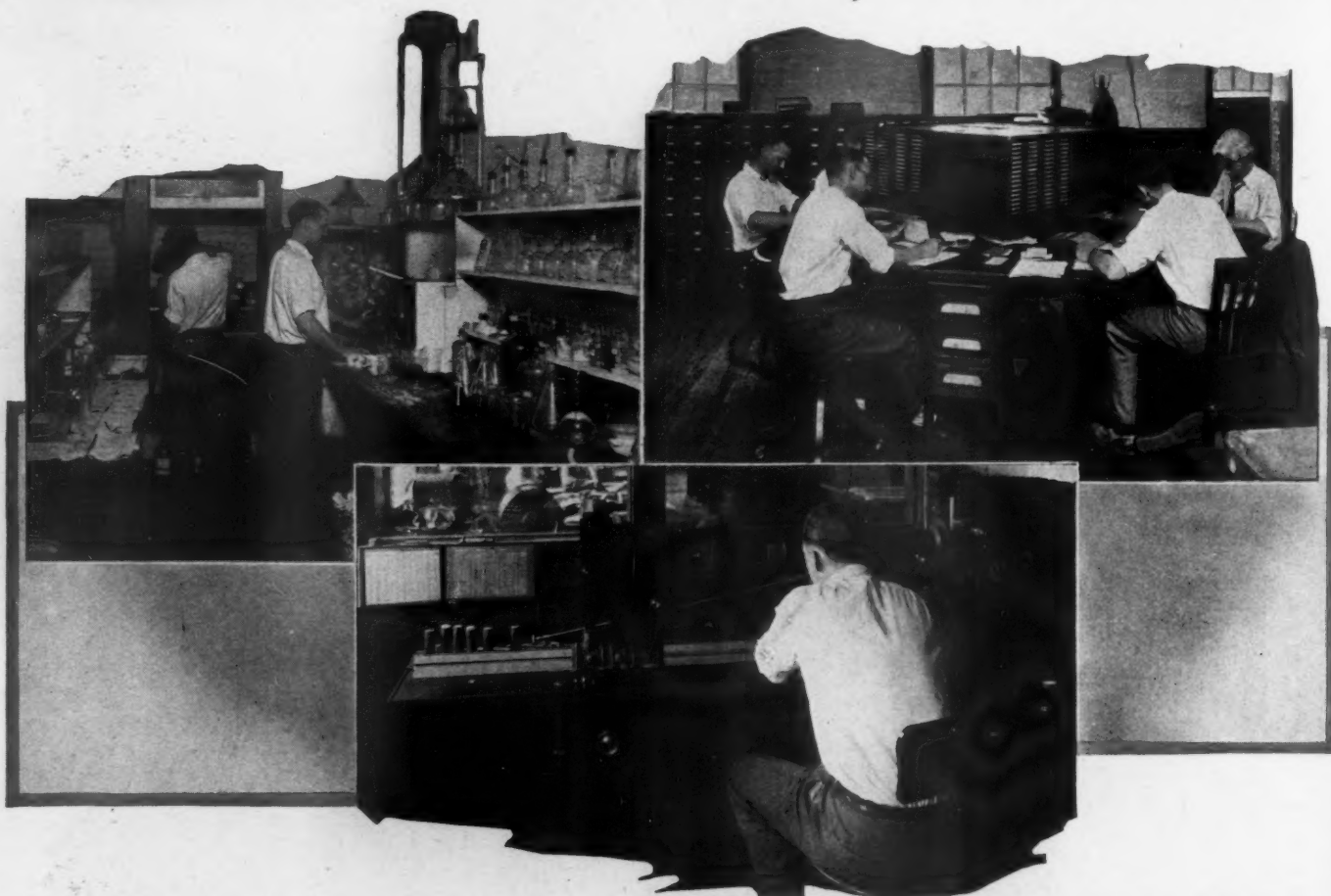
the modern wonders of metallurgical practice, but it calls for continual watchfulness and the precise regulation of the factors of time and temperature. Of course, the things already mentioned might count for naught if the machinist should be negligent or fall in performance below the very exacting standards now prescribed in the manufacture of really first-class pneumatic tools.

We have hastily sketched some of the outstanding features of pneumatic-tool manufacture; but possibly the amazing evolution of air-driven tools can be more understandingly grasped if we outline what goes on in an up-to-date plant engaged in this line of production—such, for example, as the fine plant of the Ingersoll-Rand Company, lo-

Caïd Peck and Erastus Kellogg, who formed a partnership for the manufacture of boilers and marine engines and a rotary air drill invented by Caïd Peck. That single tool constituted the cornerstone of a business that was to grow in the course of years to splendid proportions. During the first week of the partnership there was only a handful of men on the payroll; today the force runs into hundreds. This is surely an index of progress.

The Athens shops are now turning out no fewer than 20-odd different classes of pneumatic tools. These are produced in anywhere from 2 to 40 different sizes, and with such modifications as will enable them to meet successfully the varying demands made upon them in wide fields of service. Broadly stated,

of the company's pneumatic tools. Therefore, all steels, castings, and forgings received from outside sources of established high standing are subjected to laboratory test and inspection before they are issued to the workmen in the various departments. In fact, there are approximately 100 different grades of steel used in the plant—each being particularly suited for the service expected of it. Each of the departments which work up the steels or finish the operations required on castings or forgings does one or more things in partly or completely finishing one or more parts of one or more pneumatic tools. The machines provided for this purpose are the best that can be obtained. In some instances they are virtually as wonderful in their get-up as so



Left—Chemical laboratory in the Athens plant where all steels and other materials must pass certain prescribed tests. Bottom—Examining fractured steel bars by means of a microscope to ascertain some of the physical characteristics of the material. Right—The "cardex" that is used to maintain a perpetual inventory and stock-control record at the plant.

cated at Athens, Pa. That plant is a veritable monument to the industry—a monument that is unfinished because it continually mounts higher in the plant's urge to improve what at present may seem to be best, and, at the same time, to turn out tools that will serve new purposes. This attitude is merely another expression of the spirit of the time and added proof that the producer who would hold his lead must never lag. Inventiveness and resourcefulness bring their own rewards; and the Athens plant of today verifies this.

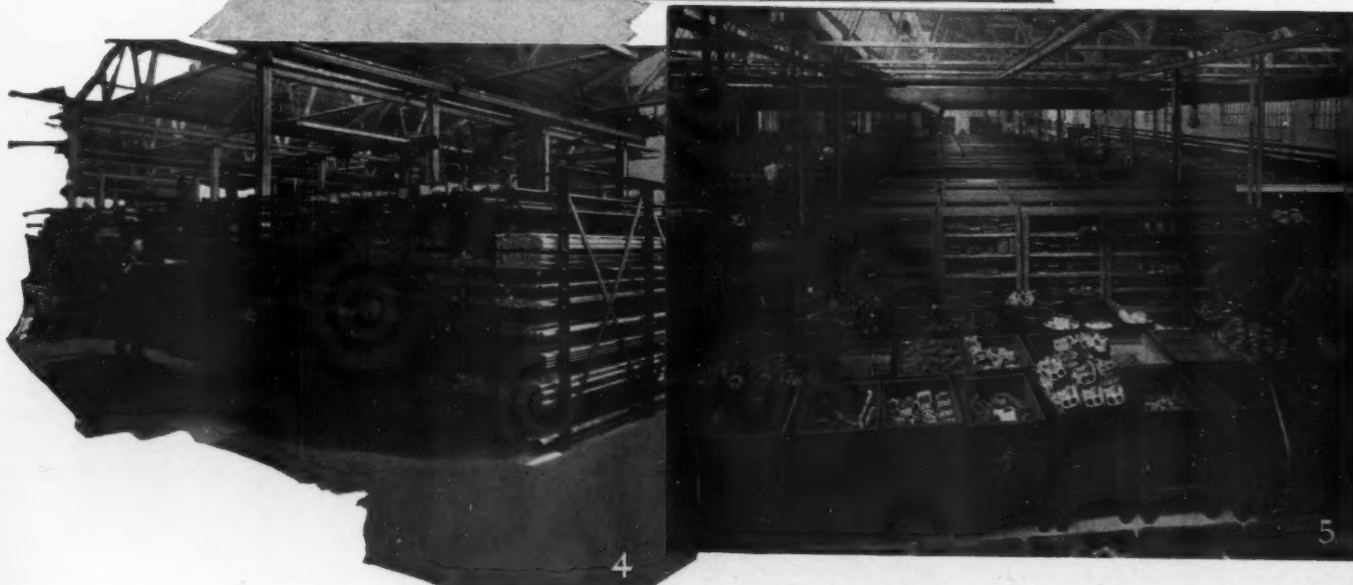
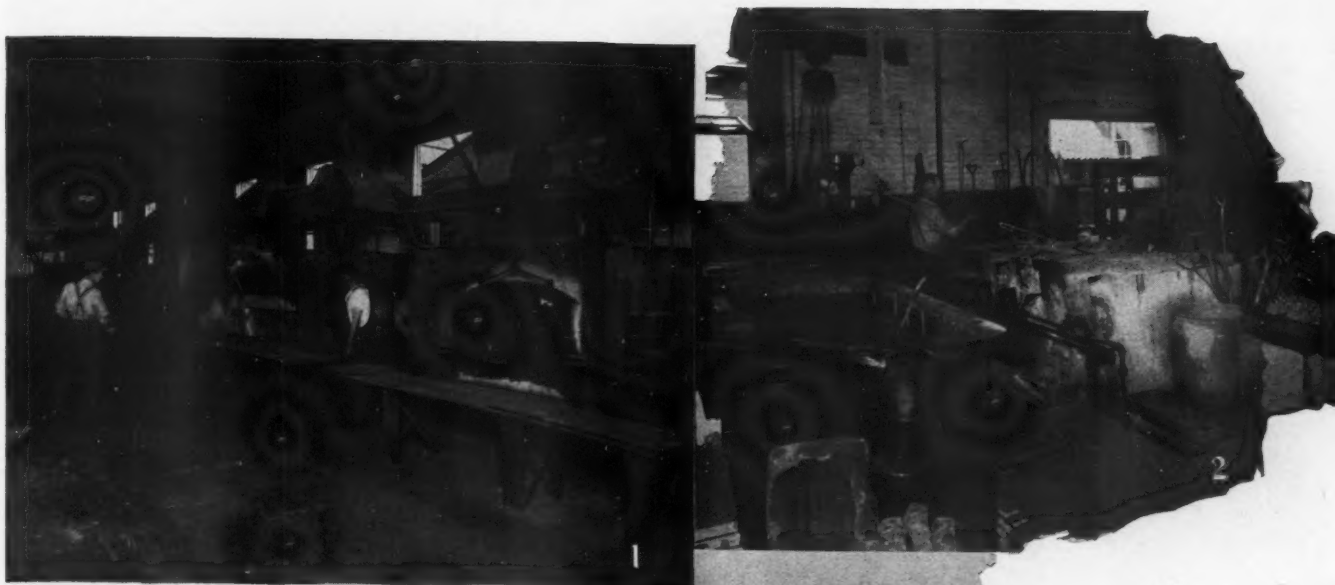
The Athens plant is the outgrowth of modest shops built on the site as far back as 1895 by the late Charles Kellogg. After their completion the shops were rented to

these tools consist of chippers, core breakers, clay diggers, riveters, holders-on, drills, grinders, saws, hoists, stationary motors, sand rammers, tie tampers, rail drills, spike pullers, track wrenches, etc. Our story would read like a catalogue if we described these tools in any detail and told how they are employed; but it is no exaggeration to say that air-driven tools are now being utilized for scores and scores of services, and each use is just one more evidence of the helpfulness of these aids and of their astonishing adaptability.

In the Athens plant the policy rigidly adhered to is that nothing is too good in either material or workmanship for the manufacture

many big watches; and in the refinements of their operation and performance they are no less exact. The piston bores of all tools are now ground to dimension—another example of superior workmanship.

The modern pneumatic tool must be so built that all of a given size and type are precisely alike: this is essential so that worn or broken parts can be immediately replaced with identical spares. This would be impossible if the tools, jigs, and fixtures used in repetitive operations were not of the highest order. The Athens shops make all their own fixtures, jigs, etc., so as to insure accuracy at every stage of work. The precision in performance realized is due in part to the use of



1—Battery of oil furnaces in the heat-treating department. Temperatures are controlled by electric pyrometers. 2—Heating steel parts of pneumatic tools in pots filled with molten lead preparatory to hardening. 3—Sand-blasting room where scale, irregularities, etc., are removed from metal parts by sand blown with compressed air. 4—Some of the many different sizes, forms, and kinds of steel stock used in the manufacture of Ingersoll-Rand pneumatic tools. 5—Lots of incoming forgings and castings received from outside plants that specialize in such products.



Left—Testing a chipping hammer. It must cut a prescribed amount of metal in the course of 60 seconds. Right—Testing the governor of an air motor for a long-stroke drill. Bottom—Section of the inspection department. Operator at right is testing the bore of a riveting-hammer barrel with a star gage.

special equipment, the most modern jig-boring machines, etc., etc. The fixtures, jigs, and tools employed in repetitive operations are subjected to inspection at frequent intervals.

This essential supervision is exercised by the tool department, which has in its keeping several sets of Johansson gages or blocks that are accurate to within four-millionths of an inch at a temperature of 68° F. These blocks are alternately returned to their makers every four months for verification; and by having available a number of sets more than one can be used to meet current needs. In shop practice, production tolerance has a range of only two ten-thousandths of an inch between "go" and "no go". That is to say, the traditional hair's breadth would be too great a variation to be acceptable. Every time a gage in service is returned to the tool department it is rechecked before being placed in stock; and the gages in regular use in the shops are checked daily. A gage when worn to "go" size is scrapped.

Because of the extremely close work required to make interchangeability of parts uniformly possible, it is essential that the products be examined critically at every stage of manufacture. To this end, the Athens plant has what is called the centralized shop inspection department. Parts in all stages of production are sent there from every other department upon the completion of a given operation and, after being cleaned in a hot washing solution, are

severely examined by thoroughly qualified experts. Any part that falls short of the standard is at once scrapped, and no more work is done upon it. This department also routes the course of each part after it has passed the rigid inspection to which it has been subjected. Finished spare parts are placed in bins to await shipment; and, no matter whether their stay there be long or short, each is again thoroughly inspected before it is packed carefully for shipping. In a sense, the inspection department is the heart of the plant, because all work flows to it and from it sooner or later.

The uniformity in manufacture and the care exercised in turning out duplicate parts make it easy for the purchaser of any of these tools to refit them for service—a matter of prime importance when these are scattered



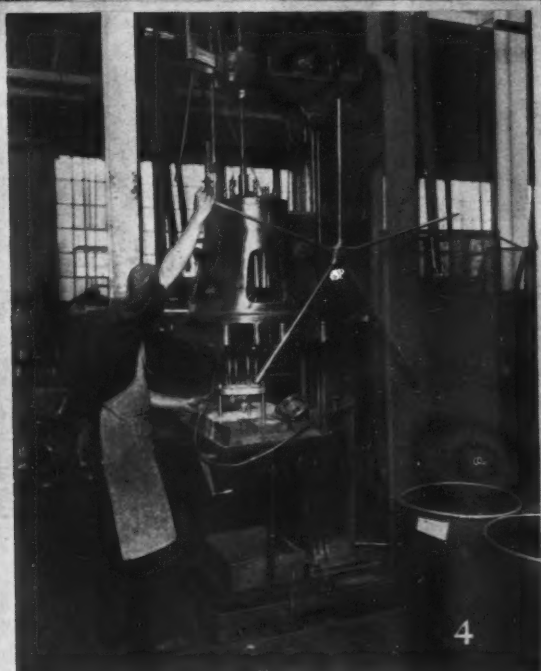
A fully assembled pneumatic drill being tested for horsepower by means of a Prony brake.

the world over. In some instances, however, the tools can best be overhauled in repair shops such as many establishments have as an incidental part of their organizations. There are, nevertheless, pneumatic-tool users that do not have such facilities, and these make a practice of sending their tools back to Athens where there is a special repair department which has a highly skilled personnel. That department exercises the same care in refitting tools for service as is displayed in turning them out in the first place.

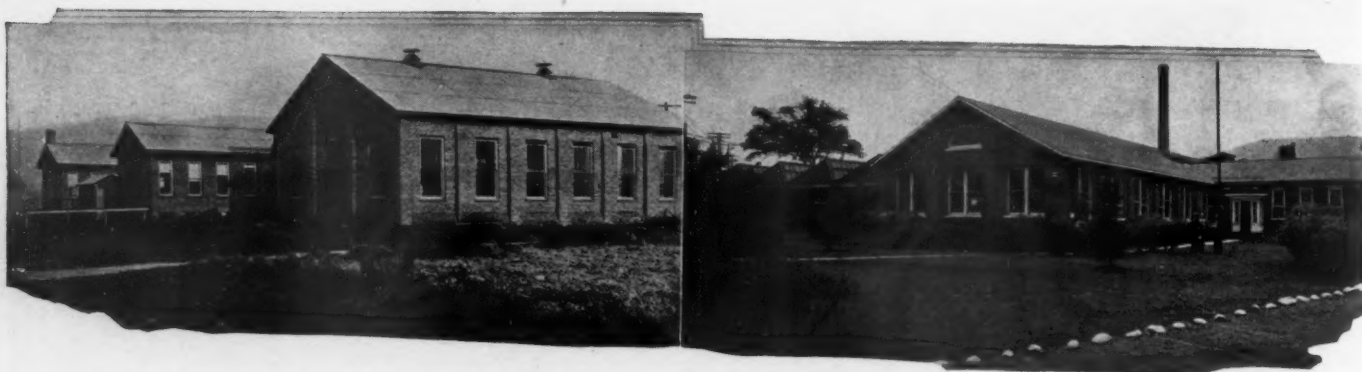
The user of a pneumatic tool commonly is unaware of the number of operations involved in turning out even a simple part. For instance, one of our illustrations shows the piston of a riveting hammer. That solid cylinder of special steel underwent nine operations, in addition to an inspection after each of them. First, there was a chemical inspection of the material; second, it went to an automatic machine for turning and for beveling one end; third, to a screw machine to have the other end beveled; fourth, to the bench department where the part number was stamped on it; fifth, to the blacksmith shop where it was heat treated to harden it so that it would withstand the rigorous service expected of it; sixth, it was sand blasted; seventh, it was ground to the prescribed outside diameter; eighth, the faces of both ends were ground; and, ninth, the outside diameter was lapped to give it the desired smooth finish. Other parts of other tools may undergo many more operations before they go into an assembled tool or are placed in stock among the spare parts. According to the character of the pneumatic tool, it may be composed of as few as four or as many as 134 different parts—and this despite the fact that every effort is made to keep the number of parts as low as possible. These figures serve to indicate how ceaseless must be the vigilance exercised at every turn to insure interchangeability of tool parts as well as dependability in the performance of assembled tools.

To most visitors, probably the assembly department of the Athens plant is most interesting. There it is that the final work is done on the tools, and there also each tool is run to prove conclusively that it is capable of doing what is expected of it. In this department each man is a specialist in the handling of the part upon which he works. The final assembly of all parts of a given type of tool is done by one man—also a specialist; and he is responsible for the performance of that tool after it passes from his hands.

Let us take the case of an air-driven long-stroke reversible drill. A drill of this sort is virtually a portable power plant equipped with a small but powerful high-speed 4-cylinder engine—the engine being hidden within a non-committal casing. Mechanically, the tool represents an engineering achievement; and it is designed for extra-heavy drilling, reaming, tapping, flue-rolling, and the running on and off of nuts. Each of these drills is provided with a simple but dependable governor that



1—Up-to-date machines of this sort make it possible to cut with accuracy any number of gears. 2—Multiple-spindle battery drill, drilling successively a number of different-sized holes. 3—A battery of automatic machines at work on bar stock and making many different tool parts. 4—A multiple-spindle drilling and tapping press drilling simultaneously a number of holes in the gear case for a long-stroke pneumatic drill. 5—Centerless grinding of a continuous flow of drill pistons. 6—Lapping at one time 28 pistons for riveting hammers.



Left—The Athens plant as it appeared between 1895 and 1903. Right—One view of the present thoroughly up-to-date Ingersoll-Rand plant at Athens, Pa.

limits the speed of the drill after the machine has reached the point of maximum power development. This governor, besides preventing the wasteful consumption of air, checks any tendency of the drill to race when it is underloaded. As a consequence, the moving parts of the motor are not subjected to harmful stresses.

When such a drill is put together in the assembly department, the moving parts are coated with a non-abrasive compound and the drill is then driven with compressed air for twenty minutes to polish and to smooth associate working parts. Next, the machine is cleaned by washing and by blowing it out with compressed air, after which it is reassembled and greased thoroughly and set up in the running-in room, where it is operated continuously with low-pressure air—that is, at 30 pounds—for from fifteen to twenty hours. Then the drill is subjected to a horsepower test, at the conclusion of which the drill is disassembled, inspected, regreased with fresh grease, and given a free-speed and endurance run at maximum horsepower for 30 minutes. Nothing is taken for granted; and only after a tool has been proved right in every particular is it considered fit to be placed in the storeroom for issue. No tool can be shipped without a test card showing just what it has done towards satisfying the extremely exacting standards of the manufacturer. Furthermore, at Athens there is a record or history of every tool ever made by that plant—a record from the beginning of its making until it leaves the shops.

It is not our intention to go further into detail concerning the stages, the processes, and the facilities employed in turning out pneumatic tools at the Athens plant of the Ingersoll-Rand Company. We believe that enough has been said to make it plain that the work is very highly organized and that the utmost of skill and care

are exercised at every turn to produce tools of a distinctly superior order. Not only that, but the personnel of the plant is especially qualified for the type of work it is called upon to do; and each contributive department does its part whole-heartedly and with a consciousness that success hinges largely upon unstinted cooperation. The members of this organization constitute a single big and contented family which takes pride in the standing won by the company's tools the world over; and, although the force has grown steadily in the years gone, still the labor turnover is remarkably low. Of the total of employees more than 60 per cent has been working there from 5 to more than 25 years. To be exact, 7 men have been on the payroll for more than 25 years; 21 for more than 20 years; 32 for more than 15 years; 81 for more than 10 years; and a still larger number for more than 5 years.

Each month, at an unannounced date, each department is separately inspected for house-keeping and for safety; and, as a result of these two inspections, ratings are indicated by stars on the bulletin board in every department. A gold star indicates "excellent"; a green star "fair"; and a red star "poor". Two green stars in succession are not tolerated. It is a source of satisfaction that gold stars

are prevalent on the bulletin boards throughout the shops. This helps to explain how it was possible during the past winter for the plant to run 126 days without a single lost-time accident. Visitors are welcome at the Athens shops, and especially so are the people that buy and use the tools made there because they can thus learn how much is done to render the tools serviceable and capable of doing the many and diverse tasks for which they are designed.

While the main divisions of the plant are engaged in turning out the company's regular line of pneumatic tools there is a particular subdivision where new models are built and exhaustively tested before being put into production. In this way advance in the art is assured, and the company is able to keep in the forefront of the industry by anticipating needs and developments. A new tool may be several years in the process of growing from plans to a finished product worthy of bearing the company's well-known symbol—recognized everywhere as a guarantee of excellence.

THE possibility of producing steel slabs by centrifugal action was demonstrated not long ago at the Canton, Ohio, plant of the Central Alloy Steel Corporation. The equipment used on that occasion was invented by Leon Cammen, and consisted of a 7-foot-diameter drum making 300 revolutions per minute. Molten steel is thrown forcibly against the interior surfaces of the drum, where it is allowed to cool and to solidify—the resulting curved slabs, upon removal, being ready to go direct to the rolling mill. The inventor claims that it is thus possible to dispense not only with the ingot mold but with the soaking pit and the blooming mill, as well, and that drums up to 30 tons in capacity can be built for the purpose.



Outward bound. The Athens plant rightly boasts that 90-odd per cent of its shipments are made the day the orders are received there.

## JACKLING FOUNDATION BROADENS SCOPE OF SCHOOL OF MINES

DANIEL C. Jackling, of San Francisco, Calif., president of the Utah Copper Company, has made provision for the establishment at the Missouri School of Mines and Metallurgy at Rolla, of which he is a graduate of the class of 1892, of the Jackling Foundation for education in the sciences and arts pertaining to the mineral industry—the purpose of the foundation being to aid worthy students through the school by means of generous loan funds, to grant scholarships, and to furnish special educational features at the school not ordinarily provided for by the state. This is in line with an earlier fund created by Mr. Jackling twenty years ago and which has already been instrumental in helping more than 300 students through the school.

The foundation, through contributions made and to be made by Mr. Jackling, will eventually total \$600,000. Of this sum \$100,000 is to be used as a loan fund and the income from \$500,000 for scholarships and special educational purposes. Under its provisions no loans are to be made during the freshman year except in unusual cases, Mr. Jackling being of the opinion that during those first months any youth with the right attitude towards his studies can support himself just as he did throughout more than half the time he attended school. During the second term the loan is not to exceed half of the average normal cost; during the third it may be increased to three-fourths; but during the fourth year a student may borrow enough money to cover all reasonable expenses.

The special feature of the Jackling Foundation is the granting of scholarships to Americans for advanced study either at home or abroad as well as to foreigners for study in America. This has for a long while been a cherished ambition of the present administration of the Missouri School of Mines and will enable it to recognize through helpful service the debt that its Director, Charles H. Fulton, feels we owe to the mining schools of the Old World for their graduates who did so much towards the advancement of mining and metallurgy in the United States before our own schools of this sort were established. The income from the \$500,000, or so-called Education Fund, is also to be used for the temporary or permanent appointment to any department of the school of special instructors not provided for by the legislature, for special research work by the staff, or for any other legitimate needs of the school, its student body, or its alumni.

The Missouri School of Mines and Metallurgy is thus in a fair way to become an educational center with a far-reaching influence, and largely through Mr. Jackling's generosity.

The first seadrome or ocean airplane landing platform is now in course of construction in Philadelphia, Pa., and is to be anchored in the Atlantic between New York City and Bermuda next spring. It will cover an area of eight acres and will carry fuel and repair shops as well as a hotel for the accommodation of passengers.

## HOW OILY IS OIL?

HOW oily is oil? That's what the man buying lubricating oil wants to know because the oilier the oil the better a lubricant it is. This question can now be accurately answered by a device developed by W. C. Wilharm in the research laboratories of the Westinghouse Electric & Manufacturing Company.

The apparatus consists of a weighted platform supported by three highly polished steel balls and resting on an equally highly polished steel plate. This plate is covered with a film of the oil to be tested. The steel balls cut through the fluid film and rest on the tightly adsorbed film built up by certain molecules present in the lubricant. The plate, which is fastened to a hinged platform, is then raised slowly by means of a crank. The angle between the plate and the horizontal is thus increased gradually until the weighted platform moves—that is, slips over the adsorbed film of molecules. The slightest movement of the platform is rendered perceptible by the action of a voltmeter connected in a circuit that is made when the platform, after moving only .001 inch, comes in contact with a needle. The tangent of the angle between the plate and the horizontal obtained when the platform begins to slide is the coefficient of friction.

In this way the device—determining the angle at which the balls will slide over their adsorbed film of lubricant molecules—measures the oiliness of the oil; and the smaller this angle the greater the oiliness and, of course, the better the oil for lubricating purposes.



Demonstration in the Westinghouse Electric & Manufacturing Company's research laboratories of Mr. Wilharm's apparatus for measuring the oiliness of lubricants.

## SOMETHING NEW IN LOCOMOTIVES

RAILROAD circles the world over are awaiting with interest the service performances of the high-pressure, compound locomotive of the Baltic type that was built secretly for the London & North Eastern Railway running between England and Scotland. This superengine was recently given its road test, and reports have it that it fully met the expectation of its designer. It is said to be the first of its kind to be equipped with a watertube boiler; and it uses steam at a pressure of 450 pounds per square inch, or about twice that normally required.

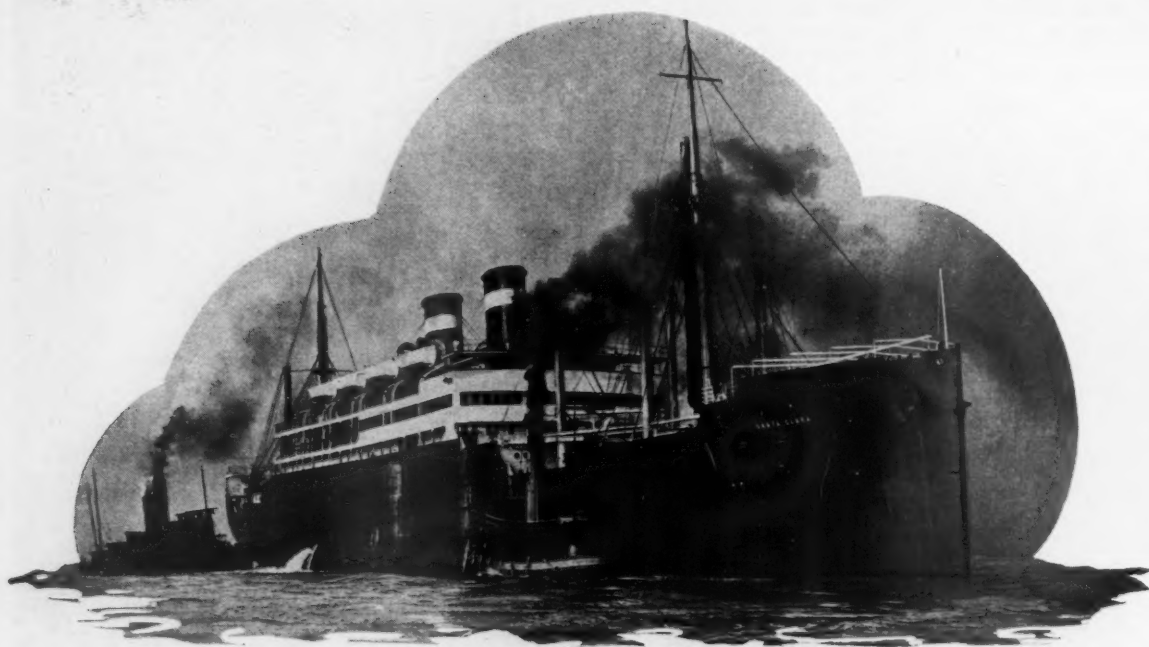
With the smokestack missing and built on stream lines, the new locomotive presents an unusual appearance. It weighs 160 tons, and is designed to draw a 600-ton train over any grade on its run at 60 miles an hour—a speed which it was able to keep up at the time of the test on quarter-throttle. But in order to appreciate just what this means it should be added that the big engines that now travel over this route are compelled to make as high as 90 miles an hour on level stretches so as to maintain the 60-mile-an-hour schedule on which most of England's flyers run.

The United States produces annually dimension granite—embracing monumental and building stone, paving, curbing, and flagging, to the value of more than \$26,000,000.

A machine has been devised that forces knots out of lumber and then fills each hole with a plug, thus putting the wood so treated in a class with lumber that can be sawed, worked to pattern, or dressed for a variety of uses to which it would otherwise not lend itself.



International Newsreel Photo  
All equipped for a flight to break the world's altitude record with a weighted plane. The flask of highly compressed oxygen serves to neutralize the rarified condition of the atmosphere thousands of feet above the earth.



New turbo-electric Grace liner "Santa Clara", a combined passenger and freight ship of 16,000 tons displacement capable of making 22 knots an hour.

## New Grace Liner Noteworthy Addition to American Merchant Marine

By R. C. ROGERS

THE Grace Line's latest contribution to the American merchant marine, that is now in process of reconstruction with the aid of the Marine Act of 1928, is the new turbo-electric passenger and freight vessel *Santa Clara*.

The building and placing in service of this fine ship, the first passenger-and-freight transport to be built exclusively for foreign trade under the terms of the aforementioned instrument, is significant for more than one reason. She is the first vessel to mark the resurgence, due largely to Government subsidy, of the American merchant marine as a world maritime power after half a century of decline during which the greatest part of American goods has been carried in other than American bottoms. And she constitutes a powerful

agent towards Pan-American accord because, by clipping five days from the time hitherto required to travel by sea from the United States to the west coast of South America, or *vice versa*, she brings these two great sea-route termini into closer contact that should lead to better mutual understanding and regard.

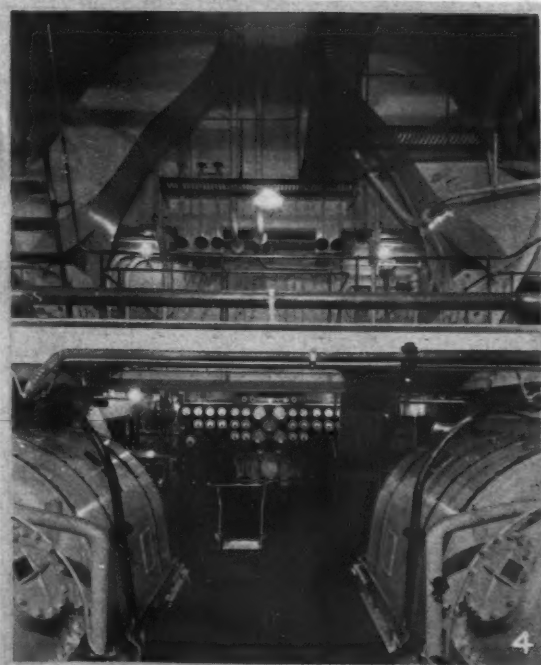
The *Santa Clara*, as operated on a fortnightly schedule in conjunction with the motorships *Santa Maria* and *Santa Barbara*, can cover the distance between her home port and Lima, Peru, in nine days and Valparaiso, Chile, in sixteen. She makes possible what has long been the ambition of North and Latin American tourists—a round trip between Lima and New York in only 21 days and between Valparaiso and New York in

36 days, with three whole days at each terminal to allow tourists to fully explore those great American cities that hold so much of interest to the sight-seer. In addition, of course, the *Santa Clara's* speed enables Europe-bound travelers from the west coast of South America to save five days in reaching their objective.

The *Santa Clara* is 504.8 feet long, and has a beam of 64 feet, a displacement of 16,000 tons, and a depth of 37.5 feet from upper deck to keel. Her staterooms, all outside, furnish accommodations for 170 first-class passengers; and her cargo holds have a capacity of 6,900 tons. Slightly faster than the motorships *Santa Maria* and *Santa Barbara*, she has a cruising speed of 18 knots, though on her trial trips she demonstrated her complete



Commodious and well-equipped staterooms aboard the "Santa Clara". Beds instead of bunks add much to the attractiveness and to the comfortableness of the accommodations.



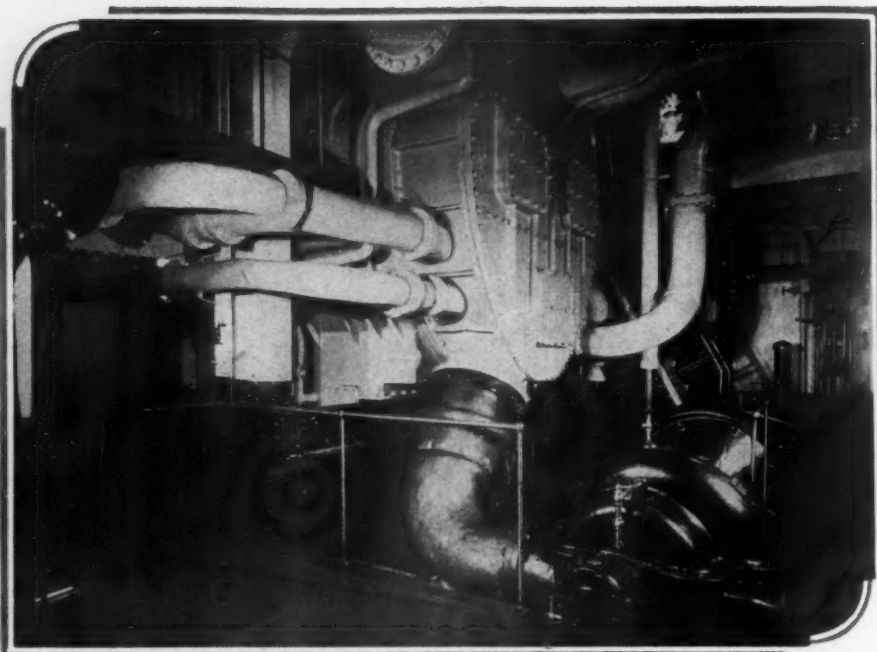
These pictures give a good idea of the character of the appointments for the enjoyment of passengers and a glimpse into the engine room where power is developed to drive the craft at her excellent speed.  
1—Smoking and cardroom. 2—Dining room. 3—Promenade deck. 4—Engine room.

capability of making 22 knots and an average speed of  $19\frac{1}{2}$  knots.

In size and arrangement the *Santa Clara's* public rooms are similar to those of the *Santa Maria* and the *Santa Barbara*, the chief difference lying in interior decoration, coloring, and furnishings. Her staterooms have been especially designed for service in tropical waters, and everything possible has been done to assure her passengers comfort and privacy. As has been stated before, every cabin is an outside one. Some have connecting sitting rooms; and there are numerous suites de luxe with private baths, as well as single rooms with showers and toilets.

The power plant of the *Santa Clara* consists of six oil-fired Babcock & Wilcox water-tube boilers and of two 4,800-kw. General Electric steam-turbine generators directly connected to two synchronous induction motors, each of 6,300-hp., which drive the ship's two propellers. The Ingersoll-Rand Company has furnished the following equipment essential to the efficient operation of the main power plant and of certain auxiliaries: two main condensers, two auxiliary condensers, two main condenser circulating pumps, two auxiliary condenser circulating pumps, three main condensate pumps, auxiliary condensate pumps, two sanitary pumps, 2-stage steam jet vacuum pumps, and a motor-driven compressor.

Much of the auxiliary equipment is electrically operated, and involves an aggregate of approximately 950 hp. in electric motors. These auxiliaries installed for the safety, comfort, and convenience of passengers and crew include such devices as a steering gear, capstans, electric cooking facilities, deck cargo-handling and boat-handling gear, and warping winches. Power for these auxiliaries is supplied by four 350-kw., 240-volt turbine generators which are driven by steam from the same boilers used to supply steam for the main turbines.



One of the "*Santa Clara's*" two main 2-pass condensers. Each has 7,000 square feet of surface and serves a 7,500-hp. turbine. The associate 18-NFV Cameron circulating pump is shown at the right.

Provision is made for long cruises at reduced speed—that is, 15 to  $15\frac{1}{2}$  knots—when only one propulsion unit is needed to drive the two main motors. At any time in regular service, however, one or the other of the generating units or of the propulsion motors may be shut down for repairs or other purposes, allowing the ship to proceed under the power of what might be said to constitute standby equipment.

A refrigerating plant, with motor-driven brine-circulating pumps, serves to cool 9,000 cubic feet of air space and to refrigerate 6,000 cubic feet of cargo space. The *Santa Clara* is, of course, outfitted with the latest devices for safety at sea, including such of the newest

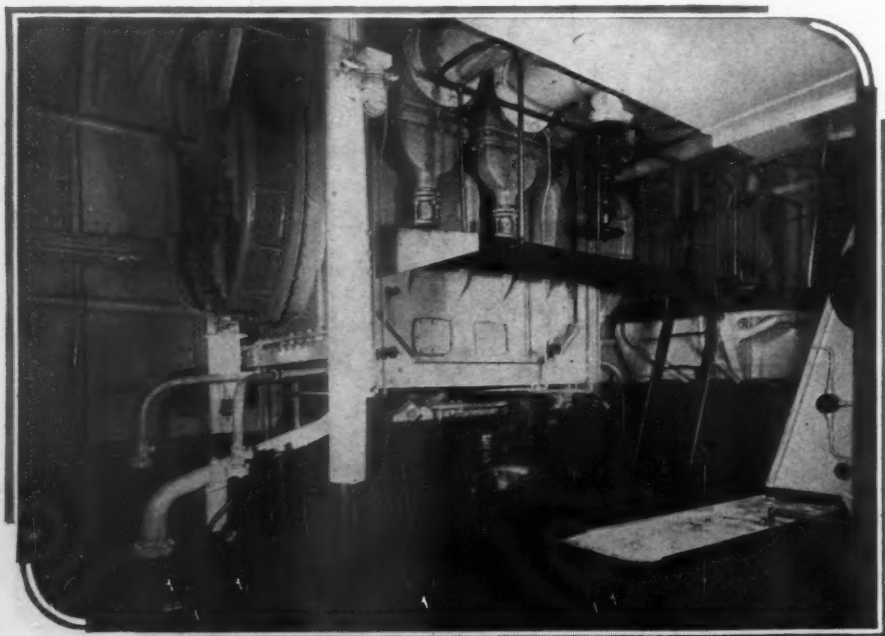
Sperry navigational aids as gyro-pilot bearing repeaters and automatic steering control of the 2-unit type. She also carries two powerful Sperry searchlights. She has been especially designed for trade along the west coast of South America; flies the United States flag; was built in an American shipyard—that of the New York Shipbuilding Company; and is powered with American machinery, in short, is an American product throughout. She was turned over to her owners early this year, and is the fifth passenger boat to be put in commission by the Grace Line since 1927.

The *Santa Clara* may be regarded not only as an important addition to the American merchant marine but also as a product of the steadily increasing trade and travel between the United States and the west coast of South America via the Panama Canal.

#### WOOL FROM VEGETABLE FIBER

**ARTIFICIAL** wool to the amount of 10,000,000 pounds was produced in the United States during 1929 and was used in the making of suitings, felts, carpets, blankets, etc. The basic material of this comparatively new product of the textile industry consists for the most part of ramie, a fibrous plant indigenous to China, Japan, and India. Efforts to grow this plant in our Southland have apparently met with success; and one of the domestic manufacturers has 12,000,000 ramie plants under cultivation in the State of Louisiana.

There are in this country a half dozen or so companies that have specialized in the production of artificial wool which, like rayon, was made possible by chemical research. Whether or not it will become as popular as rayon, remains to be seen; but it is said that wool from vegetable fiber, while not as soft and pliable as wool from the sheep's back, wears equally well.



Another section of the engine room showing one of the two auxiliary condensers. These are served by 12-NFV circulating pumps, also of the Cameron type. Air jets and coolers can be seen back of the condenser.

# World's Greatest Gold Field

*Witwatersrand Has Set Another Record that Stimulates Speculation About Its Future*



Left—Surface workings of the Modder Deep Gold Mine. Right—One of the shafts at Government Areas, on the Far East Rand, the world's most productive gold mine.

By OWEN LETCHER

THE Witwatersrand still continues to yield gold abundantly; but circumstances affecting the mining of the metal have altered much since the subject was last presented in our pages. Considerable advance has been recorded in technical practice—in fact, much has happened to the industry in the course of the past year or so. Therefore, an account of the present position and of the prospects of the world's leading gold field should be of interest to many of our readers.

With the passage of time, the steady deepening of workings, and the continuous expansion of underground areas of excavation, which means, of course, that stope and drive faces are becoming more distant from the main shafts and hauling ways, mining practices on the Rand are continually changing. The support of underground workings calls for more labor, more concrete, more waste packs, more timber than it did formerly. Narrower stoping, by virtue of which many hitherto unprofitable mines have been converted into payable ventures, implies a larger number of stope faces extended over a greater area, and more—much more—development.

Whether native labor is scarce or plentiful, the mill bins must be kept full, for the whole structure of the policy on the Witwatersrand is framed on mass-production methods, although during the past few years a more selective form of mining has been practiced there than previously. Taking into consideration all these factors it is surely a matter for congratulation that the mine managements have been able not only to negative a rise in working costs but actually to effect a slight

decrease in working costs per ton last year.

Despite a slight drop in grade, the greater tonnage milled during 1929 has enabled the Rand to establish another record in regard to the number of ounces of gold recovered. Comparative returns for 1929 and the preceding year are:

	1928	1929
Tons milled.....	30,045,100.....	30,502,800
Yield in fine ounces.....	9,907,188.....	9,980,713
Pennyweights per ton.....	6.551.....	6.489
Working revenue.....	£42,039,869.....	£42,297,268
Working revenue per ton.....	28s.....	27s. 9d.
Working costs per ton.....	19s. 9d.....	19s. 7d.
Estimated working profit.....	£12,441,718.....	£12,477,732
Estimated working profit per ton.....	8s. 3d.....	8s. 2d.
Dividends.....	£7,980,095.....	£8,085,018

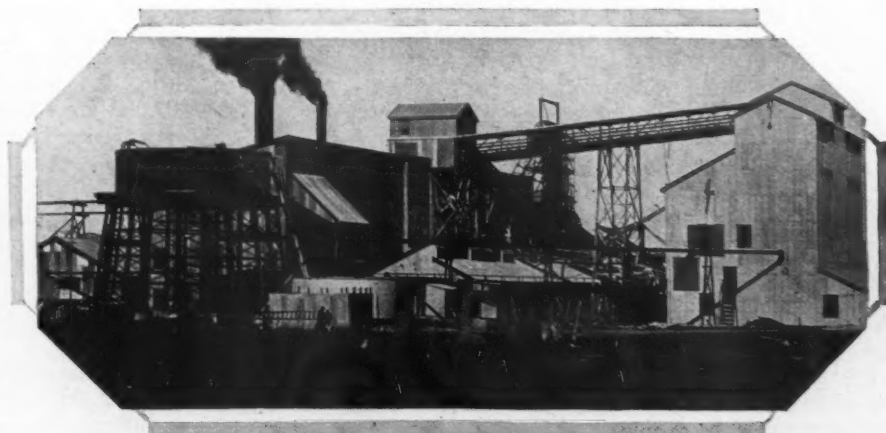
The reduction of working costs to a figure nearer the pre-war level, despite the heavy expenditure for the support of underground workings, is still hampered by the native labor bugbear and by the charges thrown upon the industry by burdensome railway freights.

There is urgent need for more native labor and for a more permanent labor force that will assist mine officials in organizing a more permanent standard of underground efficiency.

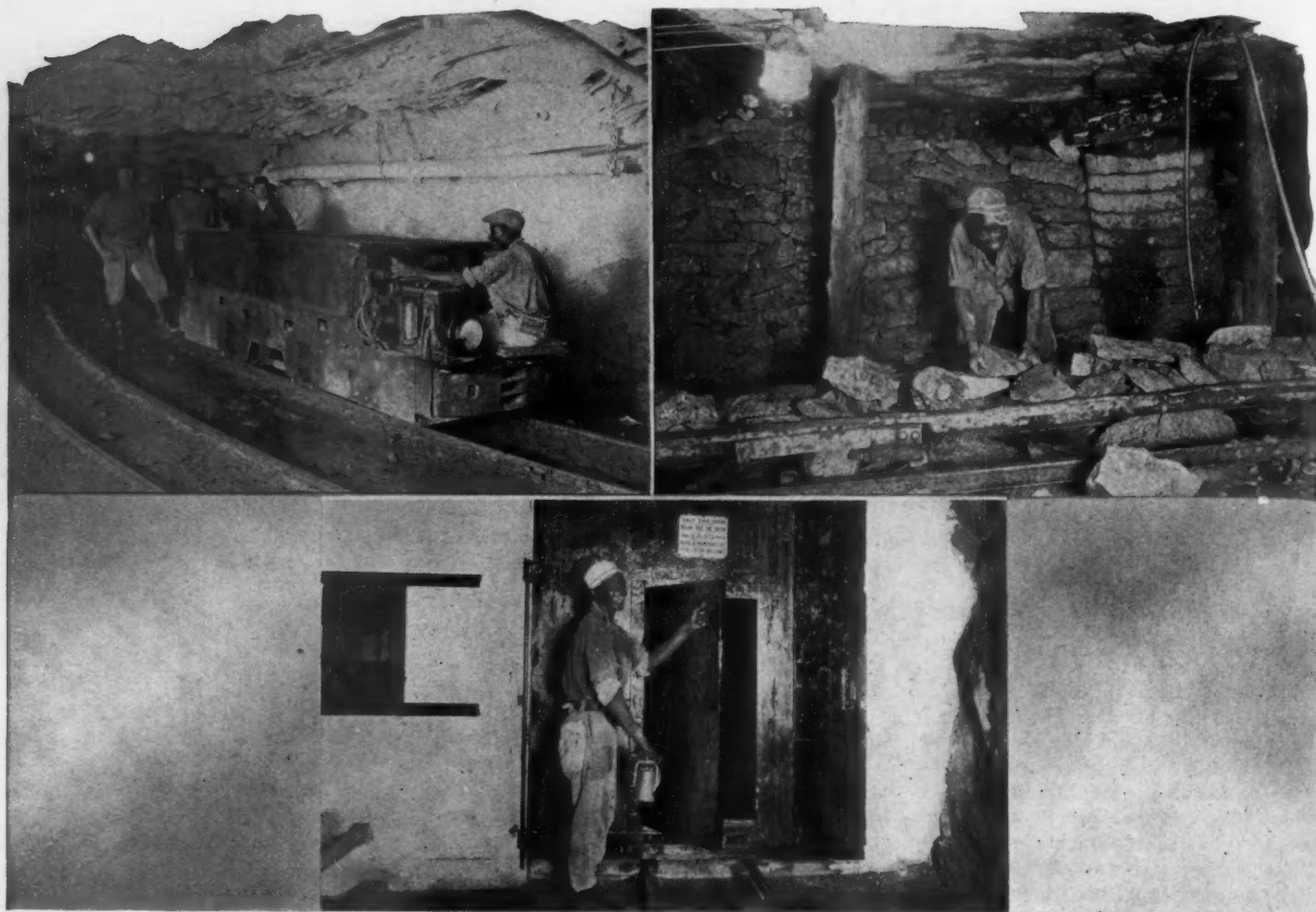
Given ample native labor there is scope for still greater outputs and that at a lessened cost, and for more employment of white workers, which will create greater industrial activity generally besides widening the market for agricultural products.

Gold is the one commodity that has an assured demand at fixed market prices. Roughly, three-quarters of the total output value remain in the country while, unlike all other exportable products of South Africa, gold is in steady demand to the utmost limit of the country's productive capacity. The result of the movement that is afoot to reinforce the native labor force from at present untouched sources of supply is awaited with keen interest; and it is from this direction that the future of the industry has the greatest hope.

The wider employment of mechanical scrapers in stopes, and the utilization of pneumatic picks for pinching down loosened ore from stope faces, are the latest notable developments in underground practice. Both are claimed to be increasing efficiency in regard to the breaking of ore and its clearance from the stopes.



Old and new mills of the Geduld Proprietary Mines on the Rand.



Left—Battery locomotive making ready to pick up a train of mine cars underground on the Witwatersrand. Right—Native worker sorting wash from an underground conveyor. Bottom—Doorway used for the control of ventilating air currents in a South African gold mine.

The merits of narrow-stope mining and of resuing are being tested in most mines, and the shrinkage system of holding up hanging by leaving reserves of ore as supporting packs is also under test. Industrial psychology is being closely studied. The training of raw native labor has been developed to a fine art. The mine managements are leaving no stone unturned to counteract the growing handicaps of increasing depth. This continual search for improved mining methods is a sign of a keen effort to improve mining efficiency so far as the human element is concerned.

Problems relating to underground hygiene and health are demanding still closer investigation. The Government of the Union of South Africa recently has appointed a commission to review the subject of phthisis in all its phases. The medical departments of the mining groups continue to devote a vast amount of attention to all forms of hygiene; and during the occasion of the visit of the British Association, Doctor Haldane's suggestions as to the substitution of less wet mining for the methods at present adopted in order to reduce humidity attracted much attention.

During 1929 three mines have closed down as a result of the exhaustion of ore bodies; three new mines are being opened up; and next year the promising East Geduld property is expected to reach the producing stage, with the Daggafontein Mine in prospect during

1932. Later on Grootvlei is likely to become active. The Witpoort property, now actively developing from existing shafts, is the third new gold producer in prospect at no distant date.

Several mines during the past year have increased their reduction plants—the most notable being the West Rand Consolidated, which has doubled its output. The East Rand Proprietary Mine has entered upon a new lease of life and, with the reinforcement of its ore reserves from the Cinderella Mine reopened after a long battle with adversity, again gives promise of dividends before long. The once practically defunct Luipaardsvlei Mine is rising Phoenixlike from the deserted-looking strip of reef body lying between the Witpoortje Break and Krugersdorp. Its new reduction plant is in operation; and this mine is expected to enter the dividend-paying stage at no distant date.

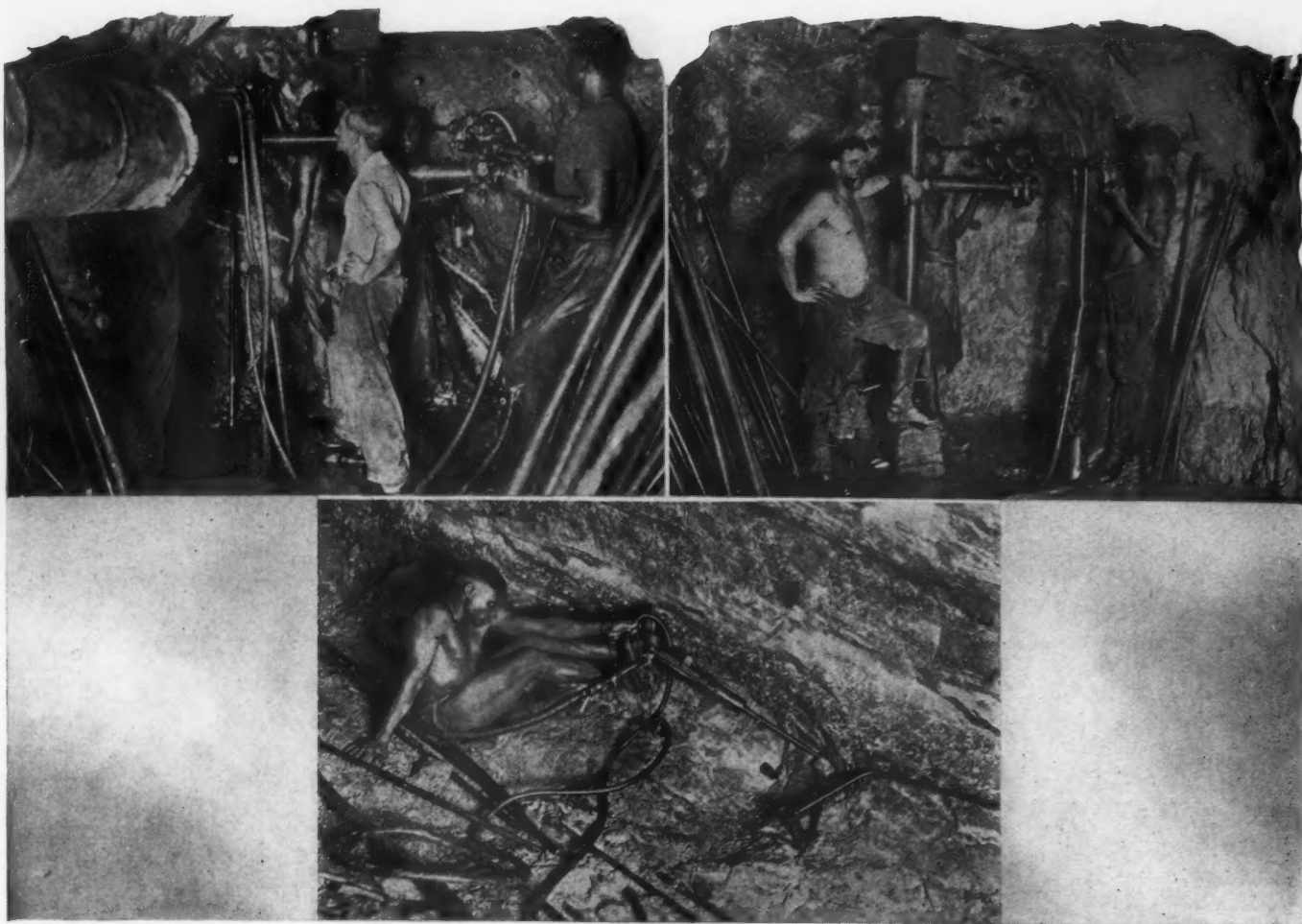
Absorption of the Village Deep by the Robinson Deep, now agreed to by shareholders, should greatly improve working conditions in the deepest section of the field and should enable the management of the enlarged property to extract the tonnages remaining in the deeper areas more economically than could be done with the two mines working separately.

The dominant consideration of the main-reef series as in other fields is, of course, the question of payability. Gold mining on the

Rand will continue, both as regards vertical depth and lateral expansion just so long as sufficient gold can be obtained adequately to cover the cost of producing gold. It is impossible to fix any limit to the distance from the surface at which some of the Witwatersrand mines may be operating ten years hence, but a maximum depth of 10,000 feet does not seem impossible.

The value of the total Transvaal gold production up to the end of 1929 has been in the neighborhood of £1,048,000,000. Included in this figure is the value of outputs from the Pilgrims Rest, Lydenburg, Barberton, and Zoutpansberg fields and also the value of gold produced from conglomerate beds in the outlying sections of the Rand proper—that is, in the Heidelberg and Klerksdorp districts. But of the colossal total of more than £1,000,000,000, the Witwatersrand main-reef series gold field, which was discovered in 1886, has produced to date gold to the value of about £1,009,000,000. Of this vast sum, approximately £780,000,000 has in one way or another been distributed in South Africa on working and capital expenditure; and, in addition, millions of pounds have been paid out to shareholders in the mines who are resident in South Africa.

The excavations underground in the shape of shafts, drives, and levels or traveling ways—excluding stopes—between Randfontein on the west and Springs on the east of the Wit-



Types of Ingersoll-Rand air-driven rock drills that are used extensively in the gold mines on the Witwatersrand. The two top pictures are of drifters mounted on columns, while the lower photograph gives an excellent idea of the adaptability of the "Jackhammer" in a difficult situation.

witwatersrand gold mines, a distance of about 70 miles, would suffice to drive a tunnel through Africa from Cape Point to Cairo, or to traverse the Atlantic Ocean from England to the United States of America.

The great secret of the success of the Witwatersrand gold field, as a whole, is that by the adoption of mass-production methods, implying efficient management and the provision of large amounts of capital, working expenditure can be maintained at a reasonably low level. The immense scale upon which operations are conducted is scarcely realized even by residents of Johannesburg and employees of the mines; and it is here proposed, by means of a few simple similes and comparisons, to give some idea of the magnitude of the mining and the milling going on there.

To date, some 730,000,000 tons of rock have been hauled out of the gold mines of the Witwatersrand in order to recover approximately 230,000,000 ounces of gold valued at a little more than a thousand million pounds sterling. In the year ended March 31, 1929, the goods' trains of the entire South African railway system ran 30,646,429 miles and conveyed 26,498,129 tons of traffic. The gold mines of the Rand during last year handled approximately 10,000,000 more tons than did all the goods' trains of the Union's railways during a comparable period.

There are three mines on the Rand—Crown

Mines, Government Areas, and Randfontein—milling each an annual tonnage exceeding the weight of the entire maize crop of the Union. The total tonnage produced by all the gold mines of the Rand in one month approximates the combined total tonnage of goods of all kinds handled at the harbors of Cape Town, Mossel Bay, Port Elizabeth, and East London in a year.

The largest stamp battery on the Rand is that of the Randfontein Central Gold Mining Company. It contains 600 stamps, and is the biggest mill under one roof in the world. The total length of the mill is 630 feet, or much the same as that of the new Union Castle liners *Carnarvon Castle*, *Windsor Castle*, and *Arundel Castle*.

For every ounce of gold won approximately 3 tons of ore are milled; and each pennyweight of gold recovered involves the mining, crushing, and cyaniding of 320 pounds of ore. For each ounce of gold won £2.18.6 is spent by the mines on working costs covering wages, stores, etc., thus each pennyweight of gold recovered involves the expenditure of 2s. 3d.

The total labor force employed by the mines on the Witwatersrand is, in round figures, 220,000 men, both white and colored. If this army of workers were to be paraded in single rank, shoulder to shoulder, a line of men would be formed extending all the way from Randfontein to Springs, a stretch of approximately 70 miles.

#### ITALY COMPLETING TWO-TRACK TUNNEL UNDER APENNINES

WITH the holing through of the Apennine Tunnel, Italy has virtually completed a great engineering task that was interrupted by the war and that has for its object the shortening of the rail run between Bologna and Florence—that is, northern and southern Italy. It has involved the excavating, with the aid of substantially 2,000,000 pounds of dynamite, of approximately 1,950,000 cubic yards of rock and the building of 553,250 cubic yards of wall or tunnel lining. Considerable difficulty was encountered along the line because of shifting clay and exceptionally large quantities of water and gas.

The new tunnel is 11.5 miles long and, therefore, shorter than the Simplon Tunnel through the Alps; but as the latter accommodates but one track, the new underground route has the distinction of being the world's longest double-track tunnel. The stretch is free of curves, and the steepest grade is just slightly more than  $\frac{1}{2}$  of 1 per cent. An unusual feature of the tunnel is a station midway between the portals. This station is 500 feet long and has two sidings within its tunnels.

The life of cutter blades on sand dredges can be considerably lengthened if the parts subjected to wear are protected with a coating of stellite.

# Curb Market Again Outgrows Its Quarters



Underwood & Underwood

Left—Open-air market on Wall Street during the "sixties". Right—Daily scene on the board-room floor of the present Curb Exchange which will have far more commodious quarters in which to conduct its expanding business when the new addition to its building is completed.

By LESTER H. BURNS

**D**URING the last Wall Street climax of business, when the volume of securities traded reached new high levels, intense interest in stock-market operations was aroused throughout the United States. Few persons among the many millions who bought and sold stock during that period are familiar with the various steps required to consummate their purchases and sales. And fewer still are familiar with the evolution of the complex but smooth-functioning stock exchange.

All the world's leading exchanges—notably the New York Stock Exchange, the London Exchange, the Berlin Exchange, the Paris Bourse, and the New York Curb Exchange—were originally open-air exchanges. With the exception of the New York Curb Exchange, these organizations had their beginnings as far back as the seventeenth century.

Writing on the origin of stock trading in London, Macaulay, the historian, said: "During the interval between the Restoration and the Revolution the riches of the nation had been rapidly increasing. Thousands of busy men found every Christmas that after the expenses of the year's housekeeping had been defrayed out of the year's income a surplus remained; and how that surplus was to be employed was a question of some difficulty. In our time, to invest such a surplus at something more than 3 per cent on the best security that has ever been known in the world is the work of a few minutes. But in the seventeenth century a lawyer, a physician, or a retired merchant, who had saved some thousands and who wished to place them safely and profitably, was often greatly embarrassed.

"Three generations earlier, a man who had accumulated wealth in a profession generally purchased real property or lent his savings on mortgage. But the number of acres in the Kingdom had remained the same, and the value of those acres, though it had greatly in-

creased, had by no means increased as fast as the quantity of capital seeking for employment. Many, too, wished to put their money where they could find it at an hour's notice, and looked about for some species of property which could be more readily transferred than a house or a field.

"There were a few joint-stock companies, among which the East India Company held the foremost place; but the demand for the stock of such companies was far greater than the supply. Indeed, the cry for a New East India Company was chiefly raised by persons who found difficulty in placing their savings at interest on good security." Macaulay's outline of the economic reasons which brought about the creation of the London Stock Exchange can be applied to any one of the world's leading exchanges.

The earliest stock markets, however, were lacking in many essentials. Because they had no rules, regulations, or definite memberships, many unscrupulous men managed to dispose of fraudulent stock to an unsuspecting public.

**T**HE rapid growth of the New York Curb Market—now dignified by the title of New York Curb Exchange—is the best evidence of the high standard of integrity maintained by the members of that organization in their business dealings.

Public confidence in the Curb is further reflected by the rise in the price of membership since the open-air days, when a "seat" cost \$250 as against the \$254,000 which was paid for a membership in 1929.

To protect the welfare of their clients, the honest traders organized for the purpose of eliminating the undesirable element by limiting the trading to those recognized by the organization.

In all the early open-air exchanges, trading was conducted both day and night; but night trading in many countries was terminated by government orders. It is interesting to note that these attempts at government regulation came always when the stock began to decline. Furthermore, in times of great declines, brokers were accused of manipulating the market.

The first city to house a stock exchange was Amsterdam. Shortly thereafter all the stock exchanges on the continent and in England moved indoors. The first stock market in the United States was not established until after most of the European markets had withdrawn from the street. Shortly after the Revolutionary War, a group of American traders gathered under an old buttonwood tree which stood on the site of what is now 68 Wall Street. Those brokers, numbering about twelve, created an open-air market for dealing in bonds issued by the Government to defray the expenses of the war. As time went on their operations expanded to include bank and insurance stocks, and, because of the rapid growth of commerce and industry, their trading also included the stocks of many of the new enterprises.

In 1817, the open-air market moved into the Tontine Coffee House, at Wall and Water streets, and was named by the brokers "The New York Stock and Exchange Board." After several changes of residence, the organization, in 1865, moved to the site of its present impressive quarters and became known as the New York Stock Exchange.

Only such stocks and bonds were listed as had the approval of the board of governors and met all the requirements of the stock ex-



Broad Street, one of Manhattan's downtown canyons, as it was when the curb market was held out in the open. Note the telephone clerks seated in the windows of the buildings to the right.



Photos, Underwood & Underwood  
**Broker, at left, signaling to his telephone clerk, at right, who is in direct communication with his office and is in the act of transmitting an order to his broker on the floor. This signalling system is a survival of the days when the curb market operated out of doors. Center—William S. Muller, president of the New York Curb Exchange, photographed at one of the trading posts.**

change. But with the rapid expansion of industry following the Civil War many new enterprises were launched; and, as many of the stocks of those companies were not listed on the New York Stock Exchange, a revival of the open-air market was brought about. This open-air market was the direct predecessor of the present New York Curb Exchange, and had its meetings at one time on Wall Street near Hanover Street. Later it was located in William Street between Exchange Place and Beaver Street. Trading in this market began at eight o'clock in the morning and continued until six in the evening. When night fell, its activities were transferred to the Fifth Avenue Hotel, at Fifth Avenue and 23rd Street.

By 1881 the open-air market had assumed large proportions; and it continued to grow rapidly during the following fifteen years. During the "nineties" the Curb Exchange moved to a new location at Broad and Wall Streets, but because of traffic conditions the traders were obliged to go further down the street. This time they operated opposite 44 Broad Street, just below Exchange Place, and continued there until they moved indoors in 1921.

When the brokers first located at 44 Broad Street they had no definite organization and, consequently, there was no limit to a business session. Finally, in 1908, following the boom and panic of 1907, Mr. E. E. Mendels, who had been trading in the curb market for 40 years and was generally known as the "Father of the New York Curb Market," formed the New York

Curb Agency. This action was taken after the unanimous consent of the brokers doing business on the curb. A listing department was established; and, for a nominal fee, legitimate enterprises were listed and admitted to trading. Mr. Mendels desired publicity for the association in order to protect the brokers and their clients from the notorious "wild-catting" that had existed throughout the boom of 1906 and 1907.

This was the first constructive step taken in organizing the group; and by 1911 the New York Curb Market had been formed. Mr. Mendels became its first secretary. As early as 1915, members of the association began to consider the question of erecting their own

building; but when the United States became involved in the World War the project was dropped.

During the years 1900 to 1920, the open-air market gained world-wide fame because of its picturesque features. It was regarded as one of the most interesting sights in the Wall Street district. A stranger in the city, approaching Broad Street and Exchange Place, would happen upon a crowd of shouting and gesticulating men wearing headgear of the most fantastic shapes and colors—brilliant greens, vivid reds, yellows, blues, and a variety of other shades for which it would be difficult to find names.

The windows of the surrounding buildings would be filled with men, equally excited, sitting astride the sills, with telephone receivers at their ears and batteries of telephones before them. These men would also be engaged in shouting and making weird and mysterious signals to the men in the street below. It was there that many a young trader became rich almost overnight; in fact, some of the large fortunes which were ostensibly "made in Wall Street" were actually made on the curb.

In 1921 the dream of the brokers was realized when the market formally began business in its own building in Trinity Place. This event occurred on June 27, 1921. Throughout the country was voiced much favorable comment for the New York Curb Exchange was thus able to render a greater service through the medium of its own ticker system, which was established at once.



**The New York Curb Market as it appeared before work was started on the new building.**

Since 1921 the ticker service has grown each year until today it reaches more than 100 cities, and extends from the Atlantic to the Pacific and from the Gulf Coast to Canada. There are now actually two cities in the Dominion which receive this service. The vast ticker system has gained considerable popularity and increased the business of the Curb Exchange which is, today, the second largest in the world, being exceeded only by the New York Stock Exchange. As a matter of fact, the press of Europe—the leading newspapers of Great Britain, Germany, France, Belgium, Holland, and Italy, publish daily a list of New York Curb Exchange quotations as well as the trend of prices. This is ample evidence of the rise of the Curb in the estimation of the money markets of the world.

Because of this widening field of service, the quarters built by the Curb and occupied by it less than ten years have already become inadequate. More space is needed to handle the steadily increasing volume of business; and to meet this demand the present exchange is being enlarged by an addition of fine proportions. The new structure is going up immediately in front of the Curb on Trinity Place and will rise to a height of fourteen stories. The trading floor will cover 14,132 square feet, as compared with an area of 9,598 square feet in the existing board room. Besides, it will contain 24 trading posts and six half-posts, an increase of eleven full trading posts over the number now in use. The height of the board room will be 63 feet—that is, a matter of five stories. The floors above will be used for executive offices.

Construction of the new building started in February without any interruption in the business of the exchange. The front entrance of the present structure was removed, trimmed off flush with the walls. This left the board-room entrance exposed, but the opening was closed with wall board which was covered with building paper.

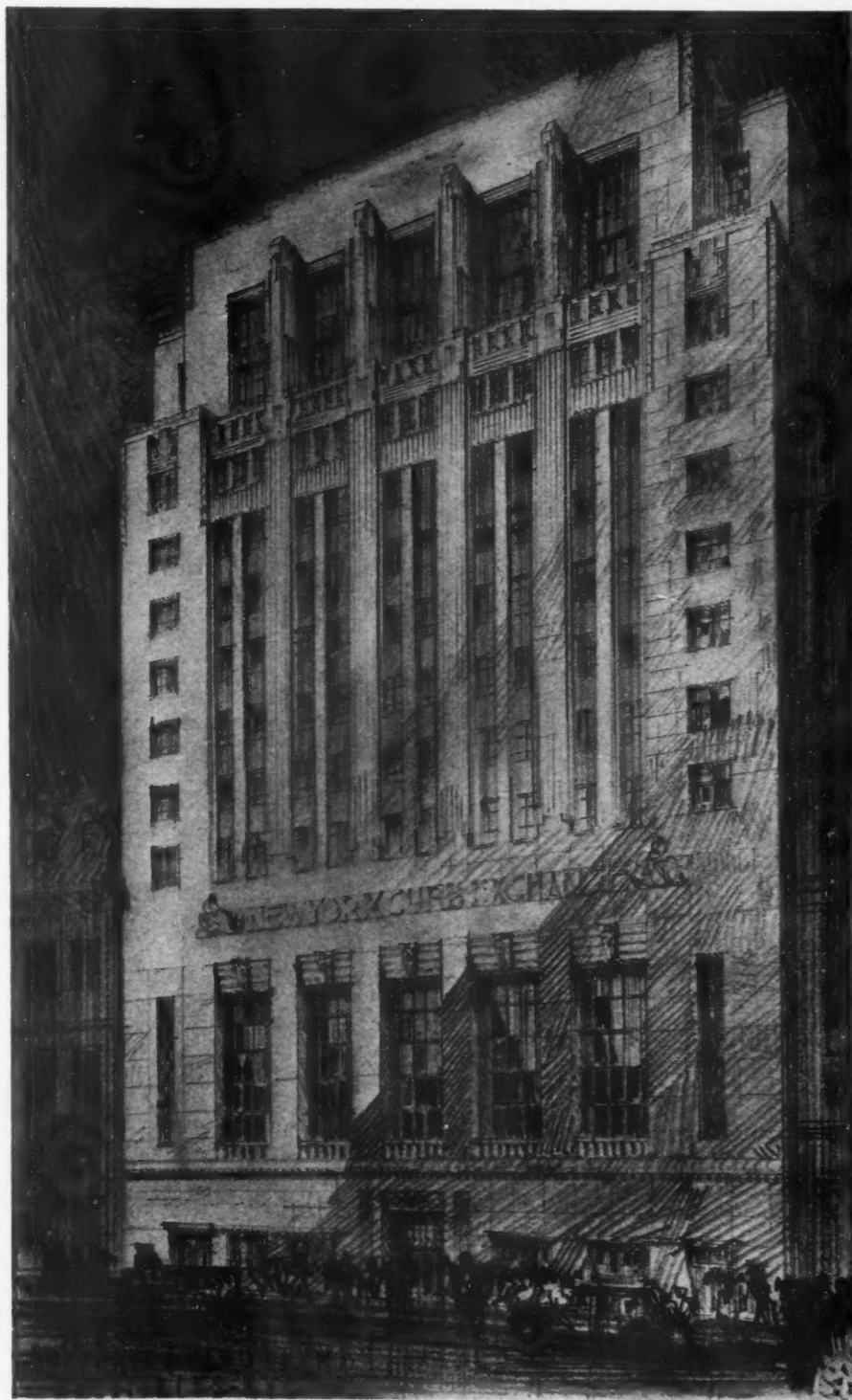
The foundation of the structure will extend 35 feet 2 inches underground. As most of the land between Trinity Place and the North River is filled in, very little rock was found near the surface. A 1½ yard Thew air-shovel was used to excavate for the foundation. The spoils were removed in 5-ton trucks and dumped on barges moored at the foot of Roosevelt Street in the East River. Although but approximately half a mile distant, the round trip cannot be made in less than from 30 to 45 minutes because of the heavy traffic in this section of the city.

When the excavation had reached a depth of 20 feet, the air shovel was taken out of the pit and the trucks were loaded by two derricks, each with a 100-foot boom. The muck was hoisted in 3-yard skips to the empty trucks on a loading platform. This platform extended out over the excavation for a matter of 20 feet. It was made of 12 x 12-inch timbers, and was supported by the sidewalk at one end and at the other by a bent of six 12 x 12-inch timbers. These timbers were 36 feet long and rested on a wood float. As the loading platform was constructed before the excavation had reached the desired depth of 35 feet, a rectangular pit was dug and

shored with 2x8-inch planks. Inside this pit the wood float was built. The pit was kept free of water, collecting as the result of surface drainage and seepage, by five gasoline pumps.

The foundation for the structure goes below

old brick foundations and sewers. These were broken up with Ingersoll-Rand CC paving breakers. Tie holes in the foundation of the present exchange were also drilled with the aid of paving breakers. In these tie holes were placed the horizontal supporting mem-



Architect's drawing of the New York Curb Exchange now under construction.

the footings of the adjoining building to the south. To support this building, it was necessary to extend the footings down to the lower line of the new structure. The additions were made of poured concrete, as the work progressed.

Deep in the excavation were found some

members of the derricks—the wall of the exchange, acting as a counterweight and keeping the derricks rigid while hoisting heavy loads. An air-operated woodborer was used for putting bolt holes in the heavy timbers which were required for the falsework.

At the beginning, the air for the various

pneumatic tools on the job was furnished by two 10x8-inch Ingersoll-Rand portable compressors. These were temporarily lined up in the street in front of the building site. Later on, when operations were well underway, a Class ER-1 electric-motor-driven machine was substituted, and this will be used until the structure is completed. In this way the portables were released for other necessary services. The air was stored in a large receiver, placed alongside the compressor, whence it was conveyed to the workings through 3-inch flexible steel hose carried under the sidewalk.

The Thomas Crimmins Contracting Company of New York City, is handling the excavation work. The engineers in charge of construction for that company are Messrs. Jorgenson and Quinn.

## NEW INDUSTRIAL GAS

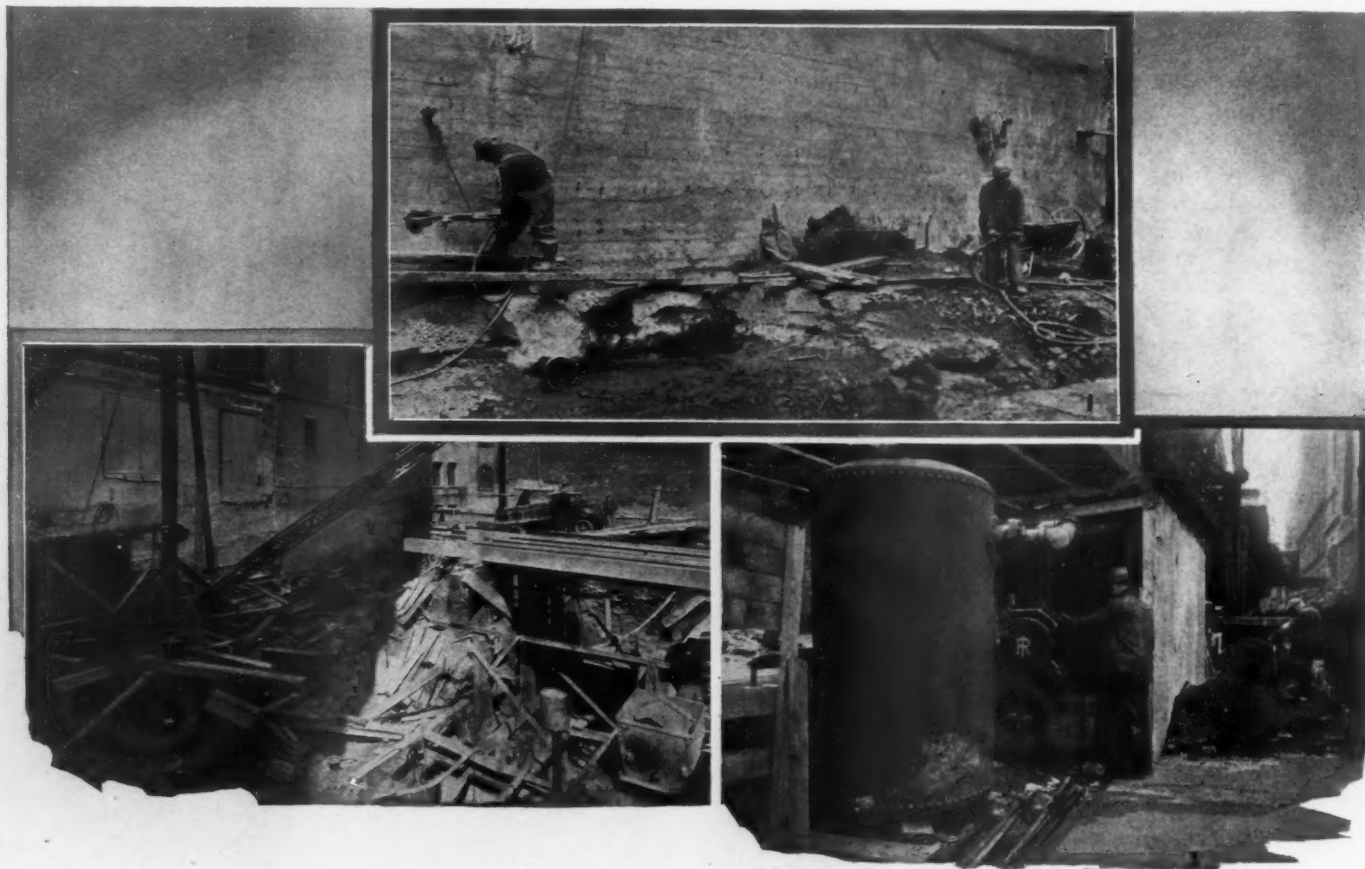
**W**HAT is described as an inexpensive substitute for industrial hydrogen can now be made from city gas or other hydrocarbons as the result of an electric cracking process developed in the laboratories of the General Electric Company. Chemically, the product is composed largely of hydrogen and carbon monoxide. Small percentages of methane and nitrogen are also present; but carbon dioxide, illuminants, and oxygen—originally contained in the city gas—are absent from "Electrolene", as the new gas is called. Its character can be made to differ somewhat in manufacture so as to meet specific needs.

Electrolene can be used variously instead of hydrogen—for example, in electric furnaces, in heat-treating, metal-cutting, braz-

works of the General Electric Company a 1,000-cubic-foot plant is in use capable of turning out Electrolene at less than \$1 per 1,000 cubic feet. An equivalent purchased gas would, it is said, cost approximately \$10 per 1,000 cubic feet.

## SAND BLAST EFFECTS SAVINGS IN BRICK YARD

**S**CALE accumulating on the tops of cars used to carry bricks in the green state is responsible for much wastage in brick-making, and money spent in removing it is well invested. These are the findings of one large yard that set out to devise ways and means of reducing the loss. At that time the average monthly output of the plant was 1,750,000



1—Air-operated paving breakers were used in excavating for the foundation of the addition to the New York Curb Market. 2—General view of the excavation while the loading platform was in course of erection. 3—The ER-1 compressor with its large receiver. This plant now furnishes all the air required and has supplanted the portable compressors originally on the job.

## INTERNATIONAL ROAD CONGRESS TO MEET IN WASHINGTON

**I**T has been officially announced that the Sixth International Road Congress is to be held this year at Washington, D. C. This is the first time the United States has been so honored. The event will take place from October 7 to 10, inclusive, together with an exhibition under the auspices of the American Road Builders' Association. Visiting delegates will thus be given an opportunity to study highway machinery—in short, to see what is new in the industry. An interesting feature is promised in the form of an educational display by the United States Bureau of Public Roads.

ing, etc. It burns with a high flame temperature; is especially suitable for metal-cutting because of the ease with which a neutral flame can be produced; and in heat-treating—where it is essential that the carbon content of the metal remain unaltered—it can be applied without harmful effect. Hydrogen, on the other hand, will absorb carbon from the metal while city gas or other hydrocarbons will add carbon to it.

The cracking process calls for equipment that takes up but little floor space. A typical installation, one with a capacity of 1,500 cubic feet of gas per hour, would be in the form of a cylindrical shell 7 feet in diameter and about 10 feet high. At the Schenectady

bricks, of which 3.8 per cent, or 66,500 bricks, was ruined in handling before steaming.

To make a long story short, a sand blast was provided for the purpose of keeping the car tops smooth, with the result that within a quarter of a year after its installation the wastage had been cut down to 1.9 per cent and, later, to the astonishingly low figure of 0.7 per cent. This meant the saving each month of 54,250 bricks which, at the then prevailing price at the yard, were worth \$678.12. Two men are employed to do the sand-blasting at the plant in question; and in a 10-hour working day they can clean twenty cars at a labor cost of about 40 cents a car.

# Improved Methods and Means Increase Oil-Field Output

*Intensive Flooding and Use of Oil Engines Prove Highly Successful in New York and Pennsylvania Fields*



Left—Some of the numerous tension lines operating pumping jacks located far and wide upon an oil lease. These lines are all actuated by a single hand-wheel power.



Right—Oil-storage tanks in the vicinity of the Bradford pool which lies in both New York and Pennsylvania.



Circle—Oil well being pumped with an "air head".

By A. S. TAYLOR

WHAT New York State is doing in an effort to stimulate output from the oil pools lying within her borders is of more than common interest. The method at present being employed successfully in New York State is also performing helpfully in the neighboring oil territory in Pennsylvania; and it is inevitable that this procedure will be found worth while in other sections of the country when circumstances warrant its adoption. We refer to what is broadly termed "water flooding".

New York State can very properly claim historical precedence in producing petroleum. The Village of Cuba, in Allegany County, is reputed to be the place where oil was first found on the continent. That discovery was disclosed by a French missionary as far back as 1627. The oil floated to the surface of a spring known to the Seneca Indians; and they gathered it in small quantities and prized it because of its attributed medicinal properties. Even so, petroleum had no commercial significance until after a well drilled in Pennsylvania in 1859 struck oil. Thereafter, New Yorkers gave heed to the possibilities of petroleum within their own boundaries.

In 1864, oil was reached in the State by a well drilled in the Town of Limestone—the community being in Cattaraugus County. From that day to this, New York oil—like that from neighboring pools in Pennsylvania—has been at a premium because the producing wells have yielded paraffin-base oils of the highest grade. It is from crude oil of this nature that superior lubricants are derived; and, as a consequence, petroleum of this

character usually commands the top price. Therefore, the value of the pools in question should be judged by the quality rather than the quantity of their output.

Early in the "eighties" oil was struck in Allegany County; and during the period of flush production the pools in Cattaraugus and Allegany counties reached a combined output annually of more than 5,000,000 barrels. From 1886 down to and including 1912, there was a more or less marked decline in production; and low tide was reached that year with a yield but a trifle in excess of three-fourths of a million barrels. To men long familiar with the industry, the outlook then seemed extremely discouraging; and it was frequently prophesied that the life of the fields was well-nigh ended. The outlook appeared all the gloomier when compared with the production of the great new oil fields in our western and southwestern states.

Hoping against hope, extensive drilling was done around the borders of the known fields within New York, but the drill holes failed to tap any new pools. In an effort to stem the diminishing annual yield, new wells were drilled between wells that were already producing, but that work and outlay did nothing towards increasing the general volume of production. Notwithstanding this disheartening situation, still the industrial cloud had a silver lining; and what has since developed into a notable turn for the better has depended upon an improved application of a method known to have been beneficial years previously in numerous instances. We refer to the flooding of the oil sands with water to

impel the petroleum toward the pumping wells. A bit of history would not be out of place here.

Back in the early days of the oil industry, both in New York and Pennsylvania, little if any effort was made to prevent either surface or underground water from entering a well drilled for oil, and while the unintentional flooding of oil wells in this manner at times occasioned their abandonment, still wells that had ceased to be productive were found subsequently to yield profitably. Investigation warranted the conclusion that the oil remaining in the rock or sand after the first pumping ceased was afterwards forced by the water into the area previously drained, where it accumulated and again made pumping worth while. This result was, in the beginning, purely accidental.

Finding that water would thus permit a recovery of oil in excess of that possible with pumping—especially after rock or gas pressure had been greatly diminished, some operators conceived the idea of deliberately flooding the producing area to obtain a quicker and greater return. Many of these operations were carried out heedlessly; and, in the haste to win more oil, the petroleum was so displaced in the sand that it became trapped or pocketed above the water and out of reach of the pumping well to which water instead of oil flowed. Owing to the many disappointments resulting from flooding, opposition developed to the method, and the practice fell into disrepute.

Even so, thoughtful men in the business recognized that oil could not be withdrawn

from its natural reservoir without supplying something to take the place of the oil and to substitute a source of pressure to make up for dissipated gas—generally the initial force tending to drive the oil through the rock or sand to the pumping well. The main problem was to ascertain how flooding with water could best be done, and then to utilize this

itself, may not be of the same viscosity throughout the producing areas. The sand and the rock holding the oil may vary greatly in their respective porosities; and even the form of the sand grains will tend to facilitate or to hamper the passage of oil between them. When subjected to hydrostatic pressure, therefore, the oil will naturally move in the

idea of the working principles involved and to point out that, when these are properly utilized, the flooding method may be a very profitable one.

In New York State, a turn for the better was indicated by the output of the oil pools in 1920. Four years previously there were 11,200 producing wells which had an average yield per well of only one-fifth of a barrel a day; but in 1926, with approximately 14,000 wells producing, the average daily output per well was one-third of a barrel. That is the largest recorded yield during a period of something more than 35 years. This augmented production was, in the main, the consequence of a widening resort to flooding. In 1926, output amounted to 1,956,000 barrels; in 1928 it totaled 2,603,000 barrels. Ordinary pumping methods probably withdraw less than 20 per cent of the oil in the sand, while flooding releases and makes recoverable a considerably higher percentage of the original oil in the pool. This is because the water to some extent overcomes capillary attraction and, in a measure, also tends to strip from the rock or sand the oil adhering to it.

In their annual report for 1928, D. H. Newland, state geologist, and C. A. Hartnagel, assistant state geologist for New York, made this significant disclosure: "The future life and production of the oil fields are dependent upon a number of factors that do not apply to fields using the ordinary or natural methods of production. Before the introduction of flooding methods, when the annual production in the State had decreased to about three-fourths of a million barrels, it seemed that the end of life of the fields was close at hand. Under favorable conditions, however, the results of flooding give additional recoveries of from 2,000 to more than 5,000 barrels an acre.

"A conservative estimate of future production is 85,000,000 barrels as against past production of 75,000,000. Much larger estimates have been made, but these have been based upon the assumption that favorable conditions for flooding will be found to exist in practically all the areas where flooding has not yet been tried. Owing to the fact that the floods travel slowly—from 50 to 200 feet a year—it would seem that even with an intensive program of flooding the fields will continue to produce for a period of 30 to 50 years, and that the production period, under some circumstances, can be prolonged for even a greater length of time."

The foregoing outlook is made doubly interesting when it is recalled that the producing areas comprise a combined expanse of about 50,000 acres; and extensive drilling has failed to disclose the presence of oil beyond this restricted region. Even so, there are some wells within the territory that have been yielding their modest measures of oil steadily for nearly half a century—indicating in that way the volume of the oil which Nature has stored underground for man to withdraw whenever the means devised by him shall be such as will overcome the existing physical obstacles.

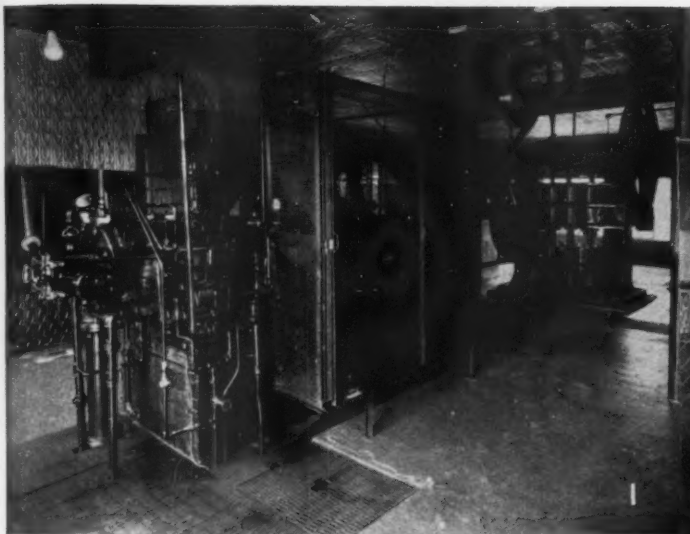
In general terms, flooding consists of drilling, down to the producing sand, a series of wells

hydraulic system in a way that would not hamper but that would be helpful. Up to date, in spite of numerous laboratory tests and much practical work in the fields, no standard practice has yet been evolved that will prove equally effectual in all circumstances. This is understandable when one is reminded that the physical and the geological conditions may differ widely and that the oil,

direction of least resistance, and that may not be in the direction desired. Furthermore, there are other conditions—among them the factor of time—which may have much to do with the action of the water and its effectiveness in displacing the oil so that the latter may be recovered at the pumping well. Our purpose is not to go into the niceties of the subject, but, instead, to give our readers an



1—Water and fuel-oil tanks at an oil-engine-driven water station in a New York oil field. 2—Pumping jack and water station in an oil-field lease near Richburg, N. Y. 3—Water station at Duke Center, Pa., which furnishes water for flooding leases in the neighborhood.



1—This up-to-date oil-field station at Duke Center is equipped with two 55-hp. PO engines which drive high-pressure triplex pumps developing pressures of from 400 to 500 pounds at the well heads. 2—A 110-hp. PO engine in Water Station No. 1 of the Bradley Producing Company, Allentown, N. Y. This efficient power unit drives a triplex pump which delivers water to the wells at a pressure of 1,000 pounds. The oil engine also drives an air compressor and a vacuum pump. 3—Close-up of the vacuum pump, air compressor, and  $4\frac{1}{2} \times 16$ -inch triplex pump driven by the 110-hp. PO engine which consumes from 85 to 100 gallons of fuel oil in the course of 24 hours. 4—A typical band-wheel power in an oil field near Bollivar, N. Y. Connections with an eccentric below the wheel operate numerous pumping jacks at different points on the lease. 5—Water station on an oil lease near Richburg. The water wells and the pumping oil wells lie in the middle distance of the valley.



1—Field storage tank in the oil-producing area of Duke Center.



2—One of numerous pumping jacks operated from a single source of power.



3—Pumping jack at an oil well delivering directly into a field tank.



4—Knee deep in mud is the chronic condition of many of the roads in the oil fields in wet weather. This makes transportation difficult.

arranged symmetrically so that by applying hydrostatic pressure to certain of them the oil in the sand will be forced toward a lesser number of wells from which the petroleum can be pumped. Various types of intensive flood patterns have been devised and tested, and these are known severally as nine-spot, seven-spot, and five-spot systems. In each unit group of these systems there is but one producing well, while all the others are water wells. The aim, of course, is to devise a pattern that will lend itself to the intensive drilling of a given lease. Needless to say there have been advocates of each pattern, accordingly as the yield of oil has rewarded employment. At the present time, the five-spot method is widely acclaimed; and it is giving excellent results in the Richburg field in New York and in the Bradford pool which lies both in New York and Pennsylvania.

Dr. Charles R. Fettke, Professor of Geology and Mineralogy, Carnegie Institute of Technology, had this to say in a recent paper read by him before the American Institute of Mining and Metallurgical Engineers: "Of the intensive development plan, the five-spot

arrangement of wells is the one that has been used most extensively. In the five-spot method the whole tract that is to be developed is laid out in a pattern of squares. Water-intake wells are placed at the corners of the squares and producing wells at their centers. The first five-spot operation in the Bradford field was attempted by the Associated Producers Company on a property in the southern part of the field as early as 1924. Frank Haskell was responsible for the idea.

"Unfortunately, the water-intake wells at the corners of the squares were spaced 500 feet apart. This proved to be too great a distance to give any appreciable results, as a core taken in the area since has shown that the sand is fairly tight and therefore requires considerably closer spacing. In cleaning out the water-intake wells later, to find out what was wrong, it was also discovered that they had not been tubed properly and that silt had accumulated in the lower portion, effectually sealing off the sand to the entrance of water. It was, therefore, not until late in 1927 and early in 1928, when the five-spot development undertaken by Arthur E. Yahn,

of Olean, on the Kuno Kuhn property near the head of Oil Valley in the northern part of the field commenced to show results, that the possibilities of the method were realized. Since that time its use has spread rapidly."

The five-spot method of flooding has been made still more effective by adding pressure to that of the static heads of the water columns of the intake wells. To do this, high-pressure water pumps are utilized, and these deliver the water required at the top of each of the water wells. This system was tried in the Richburg and Bradford pools during 1925 and 1926, and it gave decidedly promising results. Doctor Fettke tells us that those experiments did not attract much attention until two years ago. At that time, "John Messer, of Bolivar, N. Y., realizing the ideal conditions that the five-spot flood afforded for the application of additional pressure, tried it out on a property in the Richburg pool. The early results obtained were so satisfactory that the introduction of subsurface water into intake wells has now become almost obsolete so far as new development work is concerned. The wells are tubed

to take water from the surface only, and usually in such a manner that pressures of from 400 to 1,200 pounds—and in some instances more—per square inch at the top of the well can be applied. This type of flooding has come to be known as the 'pressure' flood."

The net result of flooding is the virtual rejuvenation of the oil fields both in New York and neighboring Pennsylvania; but there is an angle of this departure in practice that also calls for new means of meeting the situation. In years gone, natural gas from these fields has furnished fuel for operating purposes on the leases and for local consumption. Today, unfortunately, this fuel is available in relatively limited quantities and is worth around 35 cents per 1,000 cubic feet on the lease and sells to other industrial and to domestic consumers at from 65 to 75 cents per 1,000 cubic feet. Such being the case, operators of leases realize that they cannot depend upon the gas as the main or primary source of power, and one by one they are turning to oil engines—oil for this purpose being valued at 4½ cents a gallon on the lease and at from 7 to 8 cents a gallon delivered, the price varying with the distance to be hauled.

Some of our illustrations show water stations in which oil engines have been adopted to drive high-pressure triplex pumps and other essential equipment; and wherever that has been done the results have proved eminently satisfactory—the engines being called upon to run continuously day in and day out over protracted periods of service. Thus, a circumstance that must be faced with a reduced and rapidly diminishing supply of gas is neutralized by the use of oil as a primary source of power. Again, engineering ingenuity has met the situation and, in this way, is helping the operator to carry on and to extract profitable quantities of oil from sands that were widely believed to be on the verge of nonproduction through the systems of working heretofore considered the only practicable ones.

One can easily realize that it will take from

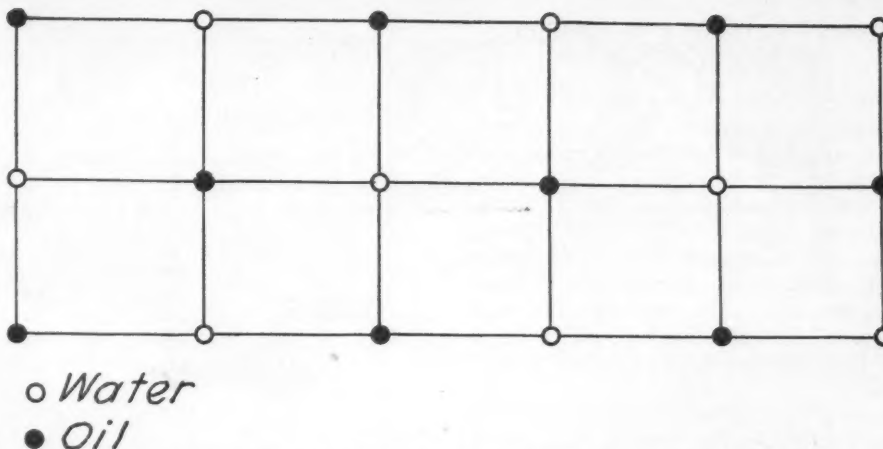


Diagram of section of an oil lease being worked by the five-spot flooding method. Every oil or pumping well occupies the center of a square with a water-pressure well at each corner.

six to eight months on a lease to work up the hydrostatic pressure to a point where it will suffice to force the oil in the sand toward the pumping wells; and another period of months usually elapses before production climbs to its maximum—even then the yield per well being highly satisfactory if it ranges between four and five barrels a day. The maximum hydrostatic pressure required and the interval between the starting of water-pressuring and the recovery of oil depend upon the so-called hardness or softness of the sand. The system pays, because the paraffin-base oils obtained in the New York and the Pennsylvania fields bring today \$3 a barrel at the source.

#### MUSEUM ACQUIRES RAMSAY'S LIQUID-AIR COMPRESSOR

AMONG the latest acquisitions of the British Science Museum in London is the liquid-air compressor used by the late Sir William Ramsay from 1898 onward for the investigation of the rarer inert gases in the atmosphere. The apparatus, designed and presented to him by a body of fellow-scientists, is of great historical interest, as it was only by this means that Ramsay was able to produce the gases neon, argon, and krypton in sufficiently large quantities to permit the examination of their properties.

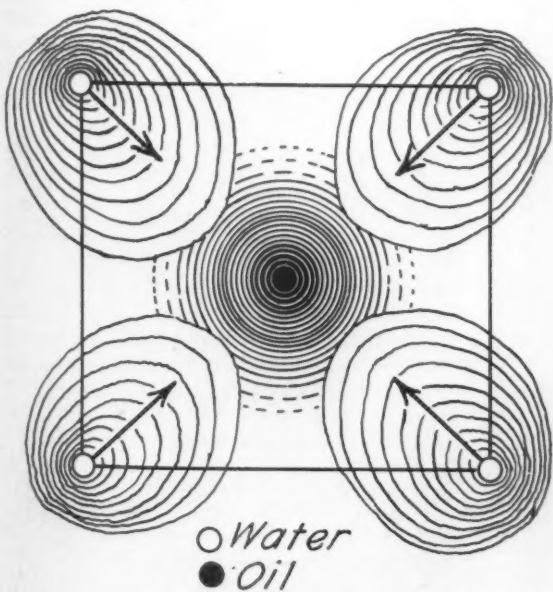
The neon globes and tubes so largely used for lighted display signs at the present day may thus be considered the outcome of his experiments with this apparatus, which had for many years been stored at London University College with the rest of Ramsay's equipment. It is now placed by the college authorities on permanent loan at the Science Museum.

An ice-cream plant, with a capacity of 55,000 quarts daily, is being built in Madrid. This is a new industry for the Spaniards who are not generally familiar with this popular American foodstuff.

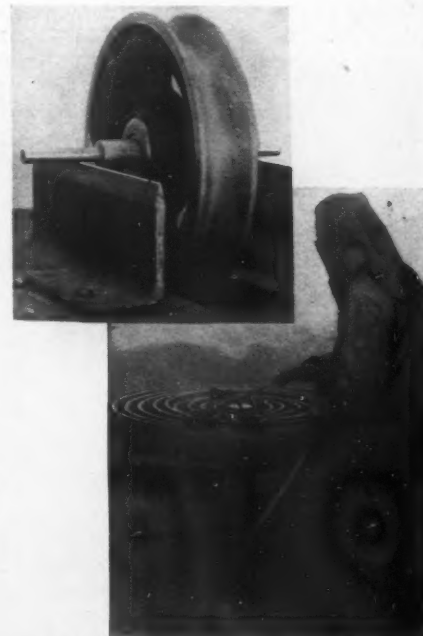
#### HARVESTING OLIVES BY A JET OF HIGH-PRESSURE AIR

WITH the prospect of having their olive crop spoiled because of a shortage of labor, reports the *New York Times*, the Tunis growers saved the situation by the timely offer of a \$2,000 prize for a machine that would do the work without injury to the fruit as well as to the trees. A machine was forthcoming, in fact among the methods proposed and tried were three that were found to possess sufficient merit to justify dividing the money among the respective inventors.

The first prize of \$1,000 was awarded for a combined picker and harvester that made use of a jet of air of sufficient strength to bring down the olives and of a suitable receptacle in which to catch the fruit. So promising has been the work done by this outfit that the growers have offered another award for its improvement.



Sketch of a five-spot-unit area illustrating in principle the manner in which water pressure drives the oil through the sand toward a central oil well.



Cleaning and smooth-finishing large and small trolley-car wheels in one operation by means of the sand blast in the shop of the Market Street Railway Company of San Francisco, Calif.

## SPRAYING QUARTZ TO MAKE BIG TELESCOPE REFLECTOR

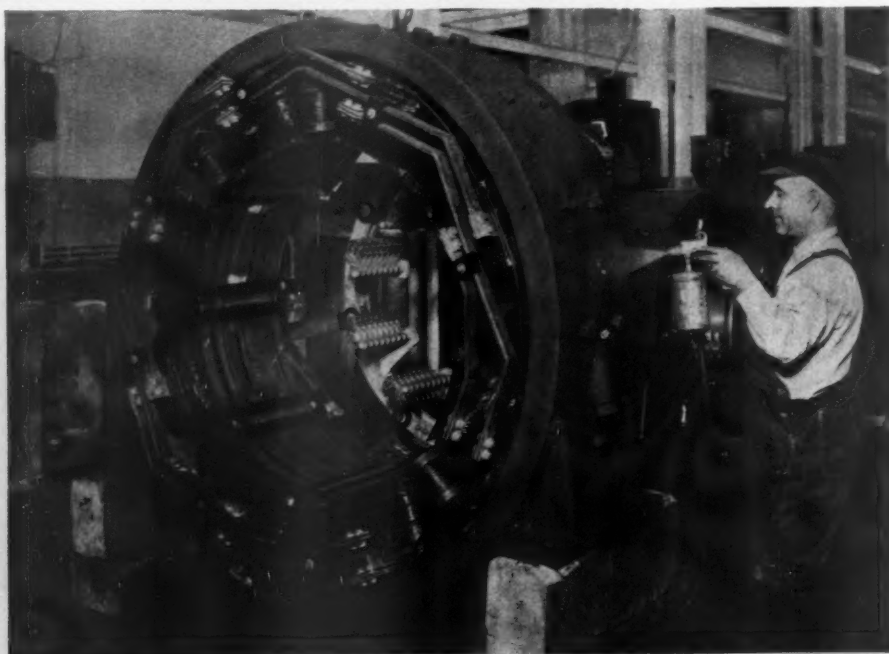
THE paint spray has suggested a way of making the reflector for a big telescope which, we are told, will enable man to peer four times farther into space than ever before. The new instrument is being built at an estimated cost of \$6,000,000 for the California Institute of Technology. Although but twice the diameter of the present largest telescope, its big 200-inch mirror will collect four times as much light and, therefore, will reveal to man just that much more of the celestial realm.

About a year ago, when work on the instrument was begun, the question was how to produce the huge smooth quartz-glass surface required. Nothing approaching the reflector in size had ever been attempted. The first two efforts were failures, and consisted of melting tiny bits of quartz and large slabs, respectively. Then it was that a laboratory worker suggested trying a method of application not unlike that used in the automobile industry to paint car bodies—that is, the paint spray. This was acted upon. The quartz was ground to the fineness of flour, and this powder was fed through a roaring blow torch which sent it flaming at 3,000°F. upon the mirror backing.

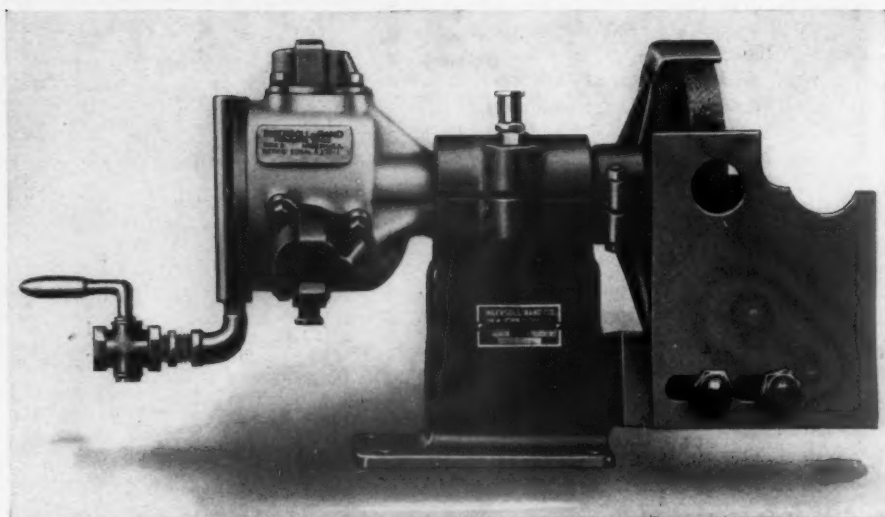
The largest disks so far made by the process are 2 feet in diameter, and these have been sent to the Mount Wilson Observatory for scrutiny and grinding. On the strength of the favorable comment received from the astronomers there a 60-inch mirror is thus to be made this summer. "If that is a success," says Dr. Elihu Thomson of the General Electric Company who is in charge of this particular phase of the work, "then we shall prepare for the 200-inch size with one more intermediate step." To do this a special foundry will have to be built—one with a dome that can be lifted clear of the structure

by means of a crane. It has been estimated that the powerful oxygen-hydrogen blow torch used to apply the quartz, unless it can be modified in the meantime, will consume as much gas in making the great disk as it would take to float the average Zeppelin.

Preliminary plans for the construction of a single-tube vehicular tunnel linking Boston with East Boston, Mass., have been approved by the municipal authorities, and it is expected that the first contract on this big undertaking will be awarded early next year. According to the plans prepared by the Boston Transit Commission, the tunnel will have a length of 5,443 feet between portals and a diameter of 20 feet—that is, there will be sufficient room for two lines of vehicles. The two end sections will involve open-cut work while the underwater sections will be driven under compressed air by the shield method.



Courtesy, General Electric Review  
Applying "Glyptal" lacquer to the frame of an electric motor by means of the air spray. Glyptal lacquers come in various colors and are highly resistant to wear and to the action of heat, water, mineral oils, etc.



Air-operated pedestal grinder designed especially for mounting on a portable compressor.

## AIR-OPERATED GRINDER FOR BENCH OR FIELD USE

A bench-type pedestal grinder that can be bolted either to a bench or to a portable air compressor is one of the newest additions to the long list of pneumatic tools and equipment produced by the Ingersoll-Rand Company of New York, N. Y. This pneumatic grinder is known as the Type 9. Its motor is of rugged construction and has three interchangeable cylinders. These are spaced about the center line of the spindle and deliver power to one crankpin. All the moving parts of the motor are continuously immersed in a bath of oil to assure smooth running. The flow of air to the motor is controlled by a hand-operated globe valve.

The grinder has a free speed of 3,000 revolutions per minute; and it is designed to carry a vitrified grinding wheel varying from 6 to 8 inches in diameter and having a 1, 1½- or 2-inch face. The end of the grinder spindle is threaded to take a bit chuck to hold a drill or a reamer with a ½-inch straight shank. The grindings are exhausted through the base of the machine so as to prevent them from being blown into the face of the operator; and to enable him to hold his work steady at all times a rest has been provided for it.

A grinder for use in connection with a portable compressor should prove a very handy addition to the equipment carried by contractors, public-utility field workers, and the like, as there are always plenty of grinding, sharpening, and squaring jobs to be done that require the service of such a tool. There are probably many occasions when a machine of this description would not only save time but obviate delay and inconvenience, as well.

As the result of a process invented by a Mr. J. B. Newsom, waste stone from mills and quarries is being made into brick for structural purposes. A house has been constructed of the material, which is not only pleasing to the eye but also reduces the cost of facing a building from 15 to 20 per cent, it is said.

## CLASSIFICATION OF ORES FOR ROCK DRILLING

WRITING on the aforementioned subject in the *South African Mining and Engineering Journal*, a correspondent says, in part:

"On several occasions it has been mooted that for several classes of rock a particular type of machine drill is required for maximum efficiency. Some rocks create no difficulty whatever. In fact any stoping machine can do good work in some stopes, a variety of 'Jackhammers' only showing a narrow margin between them in the number of holes drilled per diem. There are, of course, some ores on the Witwatersrand which are not rock-drill problems at all, but steel problems, and in that respect the writer has been informed that in some stopes the rock is so hard that the steel used will not last to drill a single hole of an average length of 3 feet 6 inches.

"Anyone who has taken an interest in drill steel in a mine can tell exactly from which shaft and stope the used steel has come simply from the condition of the steel after use. Some stopes are notorious for breaking jumpers. In other stopes, again, the whole consignment of used steel is worn flat on the bit. In other stopes the drill bits are in fair condition but the loss of gage is abnormal. Sometimes the returned steel is in good condition and might have been used for further drilling. As a rule, when you see that state of steel, there is no argument but that it came from good drilling ground known as 'softfontein.'

"From some stopes a lot of bent jumpers are returned. The principal reason for this is that the steel becomes fast in the stope face and is subsequently released by being blasted out from adjacent holes. Every jumper tells a tale; but the writer is of the opinion that the mines have not benefited to the extent that they should from the evidence available. A close study of the rock drill in practice, the condition of the rock, and the behavior and state of the jumper after use would in many cases lead to a reorganization in rock-drilling practice.

"It may perhaps be of interest to know that specifying a particular machine for each class of ore is not a new idea, nor has this knowledge been gained by any scientific or experimentally ascertained facts. It is a matter of instinct, developed in the school of hard experience, and is quite familiar to some men who have mined on most of the mines between Springs and Randfontein. To give one instance: a miner reported to his officials that the class of stoping drill he had was not the best for the particular class of ore being mined, and he suggested that another type of 'Jackhammer' be substituted. The machine suggested was given him, and he increased his daily average of holes by over 50 per cent! Such suggestions are obviously worth following up."

While the writer has dealt primarily with conditions as existing in the gold fields on the Rand, what he has to say is more or less applicable anywhere where rock drills are used.



THE CANADIAN MINING BOOK, 1929. A volume of 414 pages, published by Thomas Skinner of Canada, Ltd., Montreal, Canada. Price, \$2.50 in Canada and \$3 elsewhere.

THIS book should be accessible to everyone seriously interested in the mining activities of Canada because the work contains much information in a handy form that otherwise could not be obtained readily. The book has to do with the mining laws of Canada; with brokerage charges on Canadian exchanges; tariffs or fees for mining company incorporation; details regarding mineral production; the export and import mineral trade of Canada; the mining companies of Canada; the range of prices of mining company stocks, etc., etc.

AN HOUR OF PHYSICS, by E. N. da C. Andrade, D.Sc., Ph.D. A work of 160 pages, published by J. B. Lippincott Company, Philadelphia, Pa. Price, \$1.00.

IN this age of haste and in this period of a broadened desire to know a fair amount about the many things that bear directly or indirectly upon our daily life, one must commend the technician who voluntarily sets himself the task of dealing with a department of science in terms that will be easily understood by the average layman. Doctor Andrade has achieved this in his little book on physics, and at the same time has shown other physicists how topic matter of like sort can be handled briefly, clearly, accurately, and picturesquely without a sacrifice of any essential. The book is made up of six chapters that deal, respectively, with heat and energy, with sound and vibrations, with light and radiation, with electricity and magnetism, with the quantum theory, and with the atom. Each chapter is handled in an informative and a fascinating way; and within its small compass the little book is a treasure house of knowledge in its particular realm of science.

MINING AND METALLURGICAL INVESTIGATIONS, comprising four bulletins—No. 34, on The Solubility of Iron Oxide in Iron, 75 cents; No. 36, Deoxidation with Silicon and the Formation of Ferrous-Silicate Inclusions in Steel, \$1; No. 38, Deoxidation with Silicon in the Basic Open-Hearth Process, \$2; No. 46, Deoxidation of Steel with Aluminum, \$1. These bulletins can be obtained from the Carnegie Institute of Technology or from the Mining and Metallurgical Advisory Boards, both in Pittsburgh, Pa.

IN a foreword appearing in each of the bulletins is this informative paragraph: In May, 1926, the Metallurgical Advisory Boards, in coöperation with the United States Bureau of Mines and the Carnegie Institute of Technology, began a study of the physical chemistry of steel-making. Many of the phenomena taking place in iron and steel manufacture are little understood, and it was

the belief of the three coöperating parties that an intensive study of certain of these phenomena would lead to a better operation of furnaces, to a better understanding of steel in ingot form, to a greater knowledge of the physical properties of steels with particular regard to the effect of these constituents which are, at the present, more or less indeterminate, and finally to the more economical utilization of raw materials and to sounder and more dependable steel. In view of the complexity of the problem, it was agreed that the program should extend over a period of at least five years. The four bulletins in question bear dates, respectively, of 1927, 1928, and two of 1930. Undoubtedly, they will attract much attention within the industry they are designed to aid.

STANDARDS YEARBOOK, 1930, compiled by The National Bureau of Standards. A work of 301 pages, published by the United States Government Printing Office, Washington, D. C. Price, \$0.75.

THIS is the fourth issue of the Standards Yearbook, and, like those preceding it, the volume contains much useful and valuable information while outlining the activities and the accomplishments of the Bureau. It is hardly necessary now for any one to lay emphasis upon the economic usefulness of this line of work—the benefits of standardization being generally recognized. Not only does standardization make for substantial savings in production but it gives definite values by which commodities can be judged commercially as well as legally—a state of affairs previously conspicuous by its absence.

*Facts About the Structural Steel Industry* is the title of a pamphlet issued by the American Institute of Steel Construction, Inc., New York City. In it are listed steel fabricators in the United States together with other useful data. One section is given over to a glossary of terms used in steel construction, and this should make for uniformity and a general understanding of the language of the industry.

*Looking Ahead Twenty Years in Wood Utility* is the title of a booklet issued by The Grasselli Chemical Company, Cleveland, Ohio. It has to do with zinc chloride as a preservative for wood used for structural or other purposes.

*The Great Northern Railway Electrification* is the title of a special publication issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Persons interested in railway electrification should obtain a copy of the pamphlet.



